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THE PRODUCTIVITY OF " COMMERCIAL AND PEDIGREE " VARIETIES OF GRASSES

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INTRODUCTION

THE PRODUCTIVITY OF " COMMERCIAL AND PEDIGREE " VARIETIES OF GRASSES

1. INTRODUCTION

At the beginning of the present century active interest was being shown in the agronomic characteristics of various herbage plants. The need for establishing uniformity in the seed trade also had its impact on the testing of seed samples , at first for cleanliness as regards weed seeds , and later for yield , habit of growth and , especially , date of flowering. The main improvement sought (Stapledon , 1957) was greater persistence and leafiness , a pasture rather than a hay type of grass. Work led to the differentiating of three distinct types (Stapledon , 1933); namely (1) the early , erect , lax , low tillering hay type , (2) the multi-tillered , more spreading medium -early , relatively dense , intermediate hay-pasture type , and (3) the high tillering , late flowering , dense and prostrate growing pasture type. This work came to fruition in the synthesis of herbages of the desired pasture and hay types. Through breeding and selection for leafiness and later for seed production , the Aberystwyth-bred types have become known in the trade as " S " varieties , all of which have certain features in common. The other types , which have developed over the years primarily on the basis of seed production characters , have become known as " Commercial " varieties.

Differences in yield of commercial and pedigree herbage as single plants (Stapledon , 1920-3 , Green , 1948-51) and as swards (Prendergast and Brady , 1955_{a} , $_{b}$, Hunt and Thomson , 1955 , Hughes , 1956) have been shown under cutting managements , but such differences are commonly not reflected in animal experiments when using such swards. The reasons

are many , but at times are due to the fact that sampling methods have failed to measure adequately the total herbage on offer to the animal which may well graze below the height of cut (Raymond , 1948 , Williams , 1949) : the animal then consumes more herbage than has been estimated by sampling. Evidence exists (Roberts , 1931 , 1932 , Roberts and Williams , 1940) which indicates differences in yield between commercial and pedigree swards under animal grazing conditions , though not on a closed farm system , where , in practical farming terms , there is no direct application. There exists no literature of a similar comparison elsewhere.

Surveying the present sampling techniques gross insufficiencies and lack of precision have been observed . Using existing techniques a critical attitude was maintained throughout with the hope of finding a way of either improving existing methods or formulating new ones with a view to creating greater statistical and practical precision.

The comparative simplicity of managing a simple grass or a one grass-one clover sward makes necessary the study of the total herbage production and of animal output from such swards under practical grazing conditions. It also allows a comparison between the yield of commercial and pedigree varieties , sown singly or in such mixtures as advocated by Percival (1923-4) , Gilchrist (1911) and others. The main problem in complex mixtures is the inability of many species to stand up to competition with other species either through lack of , or delay in , seed germination , or , as Davies (1928) showed , because of inter-species competition due to time of starting active growth. Italian ryegrass for instance often dominates the sward early in the season , and consequently suppresses the other constituents.

The present investigation thus seeks to measure the productivity of

commercial and pedigree swards under two different types of management , (grazing and no-grazing) to see whether similar differences obtain under both systems , and whether such yields bear any relationship to the animal returns from them. A new technique , discussed later , is employed in sampling herbage at 3- weekly intervals without the grazing animal , using a Wolseley sheep shear modified for herbage sampling. The technique is varied for sampling under the second management regime . This shear cuts down to ground level and is powered by direct drive from an Allen mower. The total amount of herbage available may be estimated by this technique.

The investigation concerned was carried out on two existing experiments at the Grassland Research Institute , Hurley, H138 (List of Experiments , 1957) , H15 (List of Experiments , 1958) , on swards established respectively in 1956 and from 1950 onwards , sown for direct comparison of both commercial and pedigree swards maintained on a closed farm system. Previous comparisons were made only of animal live-weight and wool returns, sheep alone were used on H138 : sheep and cattle were used on H15 either grazing together or singly. The techniques described have been used in measuring herbage differences , and they are checked by intake observations.

A cursory attempt was made to study the root mass under grazed sward conditions to see if there were varietal differences and to what extent clover influenced this. The root mass has been considered in terms of total organic matter accumulated in the top three inches of soil as measured by total carbon.

An evaluation of varieties that takes all these aspects into account under practical conditions is necessary on scientific and economic grounds , and refined techniques should be used for such evaluations .

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

1. HERBAGE

(a) HISTORICAL

The produce of the grass/legume sward provides by far the cheapest and most important food for the ruminant (Elliott , 1943) , and is probably one of the cheapest ways of adding organic matter to the soil. In the middle of the seventeenth century leys consisted largely of red clover , (Trifolium pratense) sainfoin (Onobrychis sativa) and lucerne (Medicago sativa) grown either as simple or complex mixtures. By the eighteenth century simple mixture consisting of ryegrasses (Lolium spp.) , white clover (Trifolium repens) and trefoil (Medicago lupulina) were much in use . On the Bedford Estates the work of Sinclair gave rise to the use of a wide range of species in seeds mixtures. Such mixtures included most of the grasses together with clovers , yarrow (Achillea millefolium), and vetches (Vicia spp.). Sinclair was the first exponent of such complex seeds mixtures . Fream (1888) and Carruthers (1882) were among his disciples along with Faunce de Laune (1882). Towards the end of the nineteenth century Elliott's work (1943) at Clifton Park convincingly favoured 3-4 year leys instead of longer duration leys. Elliott realising the importance of minerals in animal nutrition recommended in addition deep-rooted herbs such as Chicory (Cichorum intybus) , Sheep-Parsley (Carum petroselinum) , Burnet (Poterium sanguisorba) and Ribgrass (Plantago lanceolata).

(b) COMPETITION

Gilchrist's work at Cockle Park laid the first emphasis on the importance of varieties in herbage plants and greatly simplified the

seeds mixture. The main disadvantage of the complex mixtures as Stapledon et al. (1923-6) have shown , is largely due to some species makir little contribution to the sward because of poor germination and/or poor seedling development. Stapledon and Davies (1928) showed that there is inter-species competition between early and late flowering red clover , and that grasses behave similarly and place the clovers at a disadvantage. They also observed that a one grass-one clover sward gave a higher total yield when compared with a mixed grass sward with white clover.

Further work by Stapledon (1920-3) and his co-workers (Stapledon and Davies , 1928, Fagan and Jones , 1920-3 , Williams , 1920-3 , Stapledon et al., 1923-6) has elucidated many important features of grassland ecolog and built up a useful source of information which had led to the differentiation between commercial and pedigree varieties. By a system of selection from indigenous types together with a constructive breeding programme , pedigree or " S " varieties have been established in this country and similar materials are now available from overseas breeding centres.

(c) MANAGEMENT

Stapledon and Davies (1948) stressed the factor of management to maintain swards leafy and productive , and the need for fertilisers to maintain them at high levels of production to prevent degeneration. They showed that production can be measured in terms of the proportions of sown species - ryegrass , cocksfoot and clover , productivity declining as these species are reduced. Under controlled management , for example , on-and-off grazing at high fertility levels , a balanced grass-legume association (Kopland et al., 1954) can be maintained , whereas at the other extreme hard grazing with low fertility leads to sward degeneration

and in the United Kingdom to predominantly agrostis (Agrostis spp.) , fescue (Festuca spp.) and herb associations.

Old established pastures vary little in botanical composition under stable management but temporary leys or young pastures take time to attain the "climax" or stable composition for any particular environmental condition because of the slow germination and establishment of sown species. The ideal grass-clover association would appear to be that combination where maximum benefit is obtained by the grass from the clovers (Sears and Thurston , 1953) from direct (Virtanen et al. 1935 ,1937) and indirect (Sears and Thurston , 1953) return of nitrogen , while the contribution of total dry matter production by the legume remains unimpaired. In practice the problem is complicated by seasonal productivity of individual species (Corkill , 1949) by the influence of the grazing animal (Jones , $1933_{a,b,c,d}$) , by climatic conditions (Sears and Thurston , 1953) , and by the soil and management imposed. Comparing the herbage production from Aberystwyth-bred and commercial varieties sown as single plants and in complex mixtures ,Davies (1939) showed that the former were more persistent , and that higher yields could be expected from them.

(d) ESTIMATION BY CUTTING

Herbage can be evaluated either by cutting and comparison made on a dry matter and chemical composition basis (Stapledon , 1920-3 , Green , 1948-51) or by differences in productivity as measured by the grazing animal in terms of live weight , milk yields or wool production. Stapledon , (1920-3) showed that repeated defoliation of herbage reduces the yield in proportion to increasing frequency and severity of cutting , but at maximum dry-matter yield levels a poor quality material is obtained , while too severe and too frequent cutting will eventually kill the species. This

phenomenon has been reported by later workers notably Woodman et al.(1929), in digestibility studies with sheep , Watson (1950) , Wagner (1952) , Graber (1924) , Harrison and Hodgson (1936) , Gernert (1936) , Brougham (1956) , Burger et al. (1958) , Ellett and Carrier (1915) , Cooper and Saeed (1949) and Oyenuga (1957) in Nigeria.

It has been shown (Stapledon , 1925 , Taylor and Large , 1955) that the normal growth of herbage exhibits a spring peak , a fall in production and in quality during summer , and a secondary peak of yield , quality and carrying capacity in the autumn. The greater proportion of leaf to stem on a frequent-cutting system results in higher nutritive value of the sward since the leaf portion is commonly more nutritious.

Hunt (1957) , working at Auchincruive on the production of commercial and pedigree varieties of grasses under a cutting regime , recommended a mixture of two or more varieties taking into account slight differences in seasonal growth so as to avoid competition. Cooper and Saeed (1949) studied the growth and development of commercial and pedigree varieties of Lolium italicum and L. perenne in relation to the annual heading habit under various cutting managements. They found the commercial varieties were erect , early, stemmy , less dense and less persistent than the pedigree varieties. The latter were more leafy and recovered quicker after cutting. They associated persistence with a lessening in the formation of flowering stalks a prostrate habit of growth and higher tillering capacity. They also showed that too frequent cutting , at fortnightly intervals for instance , did not allow the complete recovery of roots , and this in turn adversely affected the recovery of the stem portion.

Jantii and Heinonen (1957) showed that severity of defoliation under drought conditions contributed greatly to reduced yields of herbage because

moisture shortage upset plant food translocation ; while Weaver (1958) pointed out that continued defoliation , under both cutting and grazing conditions reduced root mass.

(e) LIGHT EFFECT

Brougham (1956) , measuring light intensity at one inch above ground level in mixed swards of different heights , was able to show that the rate of growth increased with increasing leaf area per unit ground surface (leaf area index) to the point where there was complete light interception by the foliar canopy , and that an increase of 20 per cent in dry matter was obtained at the highest cutting regime of five inches over the most severe at one inch. This finding agrees with those of other workers. The angle of herbage to incident light is a contributory factor , the more prostrate the plant the greater its light interception , light utilisation and hence photosynthesis. The pedigree grasses with their greater spreading habit are better able to make more efficient use of available light than the commercial varieties which have a lower leaf area index.

(f) ANIMAL LIVE WEIGHT

Stapledon and Jones (1925-6) , Jones (1933_{a-d}) , Roberts (1931 ,1932) and Roberts and Williams (1940) have used grazing animals to measure pasture yields with varying degrees of success using live-weight increase and also wool production as the criterion. Rhoad and Carr (1945) employed the constant animal-weight approach in such evaluations but admitted difficulties in keeping animals at constant weight due to fluctuations in herbage yields and the time lapse involved , since movement and adjustment to stocking rates must be determined by weighing. Eyles et al. (1956) showed that different stocking rates especially in spring influenced live-weight increase , the higher the rate in the spring the higher the returns

throughout the grazing season. Eyles (1957) further pointed out that animal production from grass can be overestimated if no consideration is given for providing fodder throughout the whole year.

(g) CLOVER/NO-CLOVER

Any comparison between a clover and a no-clover sward must have regard to the direct transfer of assimilated nitrogen (Virtanen et al., 1935 , 1937) and indirect residual nitrogen released by organic residues in the legume sward (Sears and Thurston , 1953). In the no-clover sward these differences must be made good by application of amounts of nitrogen comparable to that released in the clover sward. The nearest information available gives a supplemental value , under cutting conditions only, of 105 lbs. nitrogen or 7 cwt. per acre Nitro-Chalk reported by Cowling and Green (1954). Raymond (1953) suggested 4 cwt. per acre as the maximum amount of Nitro-Chalk (15.5% N) that can be applied to a sward without affecting the clover content.

(h) EXTENSION OF GROWING SEASON

Voisin (1957) recommends a system of rotational utilisation of herbage and short grazing periods allowing adequate rest , differing as the season progresses , to allow full recovery of the sward and to avoid too early cropping of regrowth. Suggestions on extension of the grazing season and the use of cocksfoot to this end have been made by Stapledon (1949) , Jones (1955) , Corbett (1957) , Hughes (1948) and Davies (1948). The importance of utilisation has been stressed by Davies (1955). He reported work done at Hurley by Alder (1955) who obtained a utilisation of 70 per cent on swards producing approximately 8,000 lbs. dry matter per acre.

The evolution of seeds mixture prescriptions used in the United Kingdom has been from complex to simple , mainly because of the influence

of competition between and within species. Leafy swards although producing less dry matter per acre than the same sward in a stemmy condition , will produce more in terms of animal product. The leafy pedigree varieties also seem to be better converters of light energy than the commercial varieties. The live-weight returns from pastures increase with increasing stocking rate as long as there is no shortage of feed. Clovers have been shown to have an additional value in terms of nitrogen. Application of nitrogenous fertilisers has been shown to increase yields of herbage ; and in the extension of the grazing season pedigree varieties respond to better advantage than commercial in this respect (Green , 1948-51).

11. VARIETIES

Differences in the habit of growth and seasonal behaviour of pasture herbage led to the establishment of varieties. In New Zealand , work in the development of grassland herbage varieties has also tended towards the production of leafy and persistent types with a long growing season (Corkill , 1949).

(a) Perennial Ryegrass

Using different techniques for measuring productivity several workers, among them Hughes , (1956) , Hunt and Thomson , (1955) , by cutting and by the use of cattle and sheep respectively , have attempted to show differences which might be important. They found no difference in yield between S24 and Irish perennial ryegrass. Jones , (1932) obtained a greater live-weight increase per day from a pedigree as compared with a commercial ryegrass-clover sward. Hughes (1951, 1952) and Hughes (1956) also showed the seasonal differences in pedigree versus commercial varieties with no significant differences in total annual production. Hughes (1951 ,1952) obtained higher production from perennial ryegrass with clover in the spring

and autumn than from cocksfoot with clover ; cocksfoot gave much summer growth. Davies (1939) found that although in simple mixtures the commercial variety outyielded the bred-varieties in the first year the higher yield did not persist in the sward after two years.

Between 1948 and 1951 Green confirmed the conclusions of Proudfoot (1953) that , as spaced plants , S24 outyielded Irish by 50 per cent. Under sward conditions with clover there was no difference in total annual yield , although the S24 outyielded its Irish counterpart from April to May and August to October by 10 per cent : the difference was offset by the lower May to August growth. It seems reasonable to assume that spaced plants of S24 would cover a wider area thereby suppressing weed competition and feeding on a wider area of ground than the more erect Irish. Under sward conditions it is likely that the increase in volunteer clover observed in the Irish would have offset the better growth of S24 at both ends of the growing season. Irish suffered marked reduction in its third year under a cutting treatment.

Green found a consistent 15 - 20 per cent difference in favour of S24 after a hay or silage cut and under fairly frequent grazing by sheep. Lazenby (1957) in all cases obtained higher yields from S24 as measured in terms of relatively moisture free or air dried herbage.

(b) Cocksfoot

Jones (1932) also showed the lack of persistence of commercial cocksfoot as compared with a pedigree cocksfoot sward and a resultant greater live-weight increase from the commercial variety. He inferred that this was due to the ingress of volunteer clover into the commercial sward. Working with Danish commercial and S37 pedigree cocksfoot Green (1948-55) showed Danish to more compatible with white clover than S37 but less winter-

green and productive in the autumn months. S37 was harder grazed in the late autumn to early winter it therefore recovered less the following spring and was outyielded by Danish. When not grazed at this time both had the same spring production. Lengthened winter production with an increase in the number of grazing days accounted for an overall greater annual production in favour of S37.

Hunt (1956) , with a large number of species under a cutting regime showed that the greatest yields among the material tested came from S24 perennial ryegrass , with S37 cocksfoot next , whilst Irish perennial ryegrass and Danish cocksfoot were intermediate in production. Workers at the Edinburgh and East of Scotland College of Agriculture (1956 ,1957) showed slight , non-significant increases in yield over three years from S37 as compared with Danish cocksfoot under a cutting treatment.

(c) Italian Ryegrass

Italian ryegrass is one of the earliest of British grasses to start growth in Spring. This feature accounts in part for its major importance as a pasture plant. S22 pedigree and Irish commercial are among the highest producers within this species. Charles (1955) obtained slightly higher yields over three years for early spring growth from S22 than from Irish under grazing management conditions. During the first year Irish Italain ryegrass was superior but the yields in the second and third years were reversed in favour of S22. After a rest from the previous autumn under a cutting regime , the yield of Irish increased slightly during early March and April ; a second cut in early April showed appreciably higher yield from S22. The overall increase for these spring cuts during the second harvest year was decidedly in favour of the S22. Only very slight differences in spring yield in favour of S22 under grazing were observed

over the three years.

(d) Tall Fescue

Another early and very productive species is tall fescue (Festuca arundinaceae). Work done by Charles (1955) with commercial and pedigree varieties (Alta and S170 respectively) has shown little differences in yield in its first year of establishment but from its second year on S170 outyielded Alta by over 60 per cent . When sown pure or mixed with white clover S170 gave much less yield than S22 Italian ryegrass , the latter showing almost twice its yield. The coarseness of Alta tall fescue (Rampton , 1946) would tend to make it unpalatable if not properly managed , and Blaser et al. (1956) have shown that lower live-weight returns can be expected from tall fescue-clover swards though producing more dry matter.

111. PURE GRASS STANDS AND INFLUENCE OF NITROGEN APPLICATIONS

Yields of pure grass swards can be increased by liberal fertiliser nitrogen since clover suppression is no longer a factor. Watkins (1954) has shown that the application of one cwt. per acre Nitro-Chalk to pasture is equivalent to two cwt. per acre dry matter increase. Blaser et al. (1956) reporting on the importance of forage species for fattening mixtures for steers noted a greater live-weight increase per head per day on a grass-clover than on a pure grass sward , but the latter had a greater carrying capacity thus giving similar live-weight gains per acre. Holmes (1951 , 1954) also obtained higher returns from dairy cows when fertiliser nitrogen was applied to the swards. These returns were measured as total dry matter , crude protein and starch equivalent.

Watson et al. (1932) showed that fertiliser nitrogen increased the number of grazing days at the beginning and at the end of the season.

An increase of 12 per cent of the total annual yield of dry matter was obtained. He also showed that a wet season played an important part in enhancing yields and that fertiliser raised the spring peak production very sharply. The fall in post mid-summer production was also accentuated compared with unfertilised grass. Fagan and Davies (1930) pointed out that greater response to fertiliser application occurred with indigenous than with commercial varieties. Hughes (1956) showed that S24 perennial ryegrass responded better to inorganic nitrogenous fertiliser than did Irish perennial ryegrass.

1V. GRASS-CLOVER RELATIONSHIPS IN THE SWARD

Evidence on the beneficial contribution of clover, especially white clover , to the general increase in herbage and animal output has been measured many times ; Roberts (1931 , 1932) and Roberts and Williams (1940) showed that the addition of clovers to pastures brought about an increase of 23 per cent in live weight over a period of 10 years over a no-clover sward , cattle and sheep being used. The differences increased to the fourth year then suddenly fell in the fifth. The narrowing of the differences later on was due to the ingress of volunteer clover into the no-clover plots.

Walker et al. (1954) in New Zealand found recoveries of 60 per cent and 40 per cent inorganic nitrogen respectively from the grass and clover in a sward and suggested the use of clover to provide the necessary requirement to the grass constituent. Cowling and Green (1954) found that, measured on total nitrogen output per acre , the supplemental value of clover in the grass-clover sward was in the region of 105 lbs. nitrogen per acre. Troughton (1955) pointed out the differences in the dry matter contribution of different legumes to the sward and that S100 white clover

made a bigger contribution than S184 by being more productive.

Young (1958) studied the effect of nitrogen on root nodule formation and found that when dung and urine were returned nodulation was retarded. Nitrogen top-dressing , at a rate of 36 lbs. per acre , was beneficial ; at 80-100 lbs. the effect was nil , while at 200 lbs. per acre only small nodules developed , the nodules decayed much quicker and upper growth was suppressed. Allos (1957) also found similar response in pot experiments with nutrient solutions , obtaining a dry matter increase which was directly proportional to nitrogen fixation.

Further confirmation is found in results reported by Van Keuren and Heinemann (1958) , Heinemann and Van Keuren (1958) under irrigation , and by Jones (1936) who obtained 30 per cent in live-weight increase and 15 per cent higher carrying capacity with clover than with a pure grass sward , using sheep as the grazing animal.

Blaser et al. (1956) however , found a greater carrying capacity on a pure grass sward. At the same stocking rate perennial ryegrass gave a 14 per cent live-weight increase over cocksfoot , indigenous varieties giving greater live-weight increase per day than the commercial (Jones , 1936) . Watson et al. (1932) and Jones found that the total annual live weight in a dry and a wet year were the same;the greater per-day gain in the dry year was offset by the lengthened grazing period in the wet year. The difficulty in maintaining a good grass-clover balance for any length of time was emphasised by Jones (1932). He also showed that the clover percentage increased in a commercial sward more than a pedigree sward , thus suppressing weeds and materially contributing to live-weight increase.

V. EFFECTS OF ANIMALS

Animals by their selective grazing habit (Sears and Thurston , 1953, Jones , 1933 a,b,c , Sears and Newbolt , 1942 , Sears and Goodhall ,1948)

affect the development of the sward in a different way from cutting. The return of dung and urine too has an additive effect on the overall increase obtained. Recent work by Edmond (1957) in New Zealand pointed to the differential susceptibility of various species to treading , and the resultant reduction in dry matter obtained.

Contamination of the sward by faecal returns leads to tuftiness and greater selectivity of grazing (Norman and Green , 1958) , the dung patches having a more lasting effect , and it may cause marked changes in the development of the sward . Jones (1928) and Milton and Davies (1947) showed that with rotational sheep grazing and topdressing with fertilisers leafy productive swards can develop. Both sheep and cattle avoid herbage contaminated by their own dung but swards tend to be more evenly utilised under sheep grazing than with cattle grazing.

Work by Jones ($1933_{a,b,c}$) on the effect of animal returns on the development of the sward , later substantiated by Sears and Newbolt (1942) Sears and Goodhall (1948) , and Sears and Thurston (1953) in New Zealand , has been more recently demonstrated by Watkins (1954 , 1957). Wolton (1955) found that inorganic fertiliser nitrogen applied to a pure grass sward gave rise to greater seasonal fluctuations in total soil nitrogen than under a grass-clover sward. The ready breakdown of organic matter and the nitrogen loss occurring when nitrogenous fertilisers are applied may account for these fluctuations. Sears and Goodhall (1948) obtained an increase in yield of 33 per cent with total returns of dung and urine as compared with increases of 15 and 18 per cent when urine and dung respectively were returned individually.

In a mixture of white clover with S23 perennial ryegrass and Italian ryegrass Davis and Cooper (1951) got the greatest live-weight gain with

sheep from S100. Pedigree varieties will respond more quickly to increased fertility and make better use of faecal returns , especially of urine.

V1. FERTILITY ASPECT OF PASTURES

Laying down land to grass causes a build-up of soil fertility which can be measured in terms of crop yield following ploughing. The rate and amount of this build-up depends on the type of sward and the management imposed. Work at the Grassland Research Institute , Hurley , (1956-7_a) shows that when herbage is cut and carted off , crop returns following ploughing are less than when the sward is grazed ; and that crops following grass-clover were better than those following grass alone. The highest returns were obtained after a lucerne ley.

(a) Root Development

A study of the soil picture (The Grassland Research Institute , Hurley , Experiments in Progress , 1956-7_b) showed that there was an increase in available soil nitrogen from legume ley compared with a grass ley. The root development of swards affected organic matter , carbon , nitrogen and structure of the soil and played an important role in the improvement in soil fertility. Williams and Baker (1957) devised a method for measuring root mass and Baker (1956 , $1957_{a,b}$) showed that root mass was reduced by cutting , although the number of new roots and of tillers increased. He also showed that the amount of spring growth in perennial ryegrass was directly proportional to the amount of roots present in the previous autumn.

Sullivan and Sprague (1943) and Roberts and Hunt (1936) obtained similar reduction with root yields with cutting. Goedewaagen and Schuurman (1950) with a similar washing technique found that the development of roots under old pasture was of the order 6,500 lbs. dry matter per acre at 8

inches depth , and somewhat less in leys. Haas (1958) who used 12 inch cores also found this increase in root mass with age of pastures ; yields rose to a maximum in four years or more , and the amount depended on the species. Root development is seasonal and takes place when shoot growth is at its minimum , (Weinmann , 1948 and Troughton ,1957) increasing from fall to spring , reducing again from spring to fall. Bates (1948) showed that heavy sub-surface matting of roots occurred in a sward from two years onwards and adversely affected the production of the sward.

Work carried out by Gaponekov et al. (1958) indicated that the weight of root mass varies with species. It is greater in the grass-clover than in the pure grass sward ; Konekamp (1957) showed that on light soils the volume of roots is greater than on heavy soils and the late flowering leafy varieties produce 20 per cent more roots than the stemmy commercial types.

Although Metson and Hurst (1953) got no different results in the soil nitrogen picture at a depth of 3 inches when comparing the effects of "full return" as against "no return" of dung and urine ,they inferred that this was due to the greater proportion of clover in the "no return" plot. Nodule activity was very great with "no return" areas and in the "full return" areas the clover percentage was low and root nodule activity small.

There is evidence that fertility , as reflected in increased crop yield after ploughing up,builds up under leys for 4 and 5 years and then remains more or less constant. This is partly reflected in root mass accumulation. Higher nitrogen values are obtained as the legume percentage in the sward increases although dung and urine can influence the development by suppressing nodulation. The leafy varieties seem to produce more roots than the commercial.

V11. SAMPLING TECHNIQUES

(a) Herbage

(1) Problems

The determination of pasture yields involves the use of a number of techniques most of which are useful but which by themselves are incomplete especially in relating herbage yields to animal production. Any techniques involved should be consistent with economy of time and efficiency of effort. Cutting treatments do not simulate grazing since they cannot be selective , nor is there any return of dung and urine. Visual observations and/or photographic comparisons , though inadequate by themselves , are useful if they are used in addition to other methods of direct and more accurate assessment. Raymond (1948), Williams (1949) and Green (1949) pointed out that herbage production is underestimated if samples are not taken below the height of grazing by the animal.

Methods of determining pasture yields and estimates of animal intake are prone to errors of sampling (Minson , 1958) because of variation in the experimental material itself (Bartlett and Greenhill , 1936). It is thus possible for small though important differences to be masked. Inadequate replication or too small a sampling area (Sukhatme , 1946) can bias the results. Green (1949) found that errors can be reduced by increasing the number and reducing the size of samples. Watson (1948) and Williams (1947) also showed that variation between individual animals can affect results.

Greenhill (1936) showed that the weight of green herbage fluctuates during the day as a result of the amount of moisture on the sward ; this falls towards mid-day and is lowest between 12:00 noon and 3:00 p.m. Hudson (1933) inferred that because of this fluctuation in fresh weight of

herbage , dry matter yields provide a better basis for comparison.

(2) Yield Estimation

Brown (1954) outlined various methods employed in measuring and surveying vegetation and the shortcomings of each. Davies (1931) , Davies and Trumble (1934) , Dunlop (1933) , Donald (1941) , Sears (1951) among others , have attempted to measure the output of pasture in terms of herbage yields and/or animal output pointing out the errors involved due to sward and animal variability. Hudson et al.(1933) proposed an alternate grazing and mowing technique to overcome the effect of the diminishing returns and changing botanical composition which results from continued cutting (Stapledon 1920-3). Lynch (1947) modified the alternate technique in his " full return" method and obtained satisfactory results. Lynch and Mountier (1954) compared five different cutting treatments made under cages and found that pre-trimming of herbage reduces normal sward variability. Sears (1944) , evaluating the nature of the transfer in Hudson's grazing-mowing technique found higher variability in grazed than in mown plots. Linehan and Lowe (1946) , Linehan et al. (1947 , 1952) and Morrison and Ely (1946) have used a combined grazing-mowing technique with success.

Sampling before and after grazing , as used by Fuellerman and Burlison (1939) , is laborious and tends to increase the error of estimation, especially as the technique partly estimates the growth taking place during the grazing period. It is only efficient as a measure of what is consumed when the grazing period is very short (say 24 hours duration) and when there is little interim growth. Linehan and Lowe (1946) suggested a more complicated system with moveable cages but this increases error because of variability in the "after-grazing" estimates (Williams , 1949 and Green , 1949). Brandt and Ewalt (1939) , who used dairy cows , showed that the

clipping method of evaluating " over-estimates" the yield when compared with animal evaluation.

(3) Effect of Cages

Williams (1951) , Cowlishaw (1951) and Linehan et al. (1946) found that yields of herbage when cut under cages were greater than yields outside the caged areas because of higher temperatures and humidities promoting growth. Cowlishaw found an increase of approximately 11 per cent in dry matter. Prendergast and Brady (1955_c) have described a modified "electric-wire" cage which eliminates the differences in micro-environment the old type of wire netting cages caused. Linehan et al. (1952) suggested the use of a formula to correct for this error ; this formula may not be perfect (Green , 1949) , but may point the way to a solution.

(b) Animal Effect and "Fill"

Dunlop (1935) showed that the rate of live-weight gain depends on whether lean or fat is being laid down and pointed out the need for uniformity in experimental animals. If fat is being laid down by the animal the live-weight gain will be less than if muscle were being deposited. Differences in quantity of ingestor or "fill" also provide a source of error. Bartlett (1926) , Taylor (1954) and Hughes and Harker (1950) suggested weighing three hours after sunrise or fasting overnight as means of reducing these errors.

(c) Other Sampling Errors

Herbage sampling and animal sampling are not the only sources of error. Errors in dry matter estimation and in grinding for chemical analysis have been observed by Hesse and Kennedy (1956) , Bailey et al. (1957) and Raymond et al. (Unpublished data). The lighter , less fibrous and more nutritious particles tend to be lost . Soil contamination is likely especially with sampling to ground level (Williams , Unpublished data).

Thompson and Raven (1955) have outlined methods for the determination and correction of this.

To be efficient , sampling techniques must be devised to allow cutting below the height of grazing ; it is always necessary to have adequate replication . "After-grazing" samples are more variable than "before-grazing" cuts. Variability in animal measurements and errors due to determinations of dry matter and of chemical composition have to be overcome.

V111. MEASUREMENT OF INTAKE

As a measure of quality in grasses , animal productivity has obvious advantages (Watson ,1948) but these may not only be related to the amount of dry matter eaten but also to the digestibility of the herbage. Investigation of both these aspects is of great importance in grassland evaluation . Woodman et al. ($1937_{a,b}$) measured intake with bagged sheep and noted a wide variation in dry matter intake which was related to the quantity and quality of feed on offer , the better the quality the greater the intake. Watson et al.(1933) reported similar findings. More recently Raymond (Unpublished data) has shown that in the spring the dry matter intake per day is governed more by the live weight of the animal than by the quantity of feed on offer. Estimates of intake under more extensive conditions are , however, laborious and often impracticable.

Work by Garrigus (1934) suggested that the quantity of faeces excreted was a function of the quantity and the digestibility of the herbage consumed. This opened the way for an easier method of estimation than the one of total collection. Watson and Horton (1936_a) , however , pointed out that all faecal nitrogen is not food nitrogen but part of it is of metabolic origin. Lancaster (1949) and Homb and Breirem (1952) using the

faecal nitrogen estimation factor found good correlation between faecal nitrogen and organic matter intake. Lancaster inferred that the accuracy to be obtained from this is far greater than that of herbage sampling techniques. McDonald and Purves (1957) also found Lancaster's formula applicable in trials with hay.

The tediousness of dealing with large numbers of animals for faecal estimation caused Blaxter (1948) to suggest the use of indigestible tracers and the estimation of total faecal production from grab samples. The efficiency of a tracer lies in the fact that it should properly be neither digested or adsorbed and should be 100 per cent recoverable in the faeces. Recovery , however , is nearly always over or under par due to normal errors, a fact which reduces the number of possible substances. In America the lignin-ratio technique (Cook et al., 1951 , Forbes and Garrigus , 1948) has been used and also the methoxyl method (Richards et al., 1958) , but chromic oxide is more efficient and therefore most used.

Recent observations on the variation in the excretion pattern of chromic oxide have been made by Miller et al.(1957) who have shown that excretion reached equilibrium after the fourth to fifth day of administering following a set pattern thereafter. They found no diurnal variation in the excretion pattern of nitrogen, chromogens, or percentage dry matter in faecal output. Forbes (1949) suggested that nitrogen excretion was erratic and could only be used for estimates by establishing a regression equation. Pidgeon and Brisson (1957) successfully used tablets which allow a constant release of chromic oxide during the day. Kane et al. (1953) using chromic oxide and plant pigments as indicators obtained excellent estimates of intake .

Variation in the excretion pattern precludes the use of the grab sampling technique especially with animals always at pasture. Raymond and

Minson (1955) have devised techniques for overcoming this with sheep - cattle. With the normal acid fibre technique Raymond et al. (1954 , 1956) showed a higher error of estimation than by the use of the nitrogen component. Minson (1958) like Lancaster , suggested that the indirect method of measuring pasture is superior to sampling because of its lower level of error. He suggested that differences of ± 5 per cent can be measured by this method.

1X. CONCLUSION

This review of the literature leads to a number of conclusions :-

(1) Differences in the habit of growth of commercial and pedigree varieties of grasses have been clearly demonstrated , the commercial varieties being erect and stemmy , the pedigree varieties prostrate and leafy. The production of leafy swards of both varieties is a feature of good management: sown species tend normally to give way to weed grasses and herbs.

(2) Cutting is an established method of assessing yields. Too frequent cutting affects recovery and leads to diminishing yields of herbage , even though material of higher quality is obtained. The greater ground coverage of pedigree varieties allows quicker recovery after defoliation as a result of more efficient utilisation of light energy.

(3) Animal live-weight gain is another method of assessing output. It is probably more direct , since animal production is the final output of grassland. Animal variation and stocking rates have a direct effect on the live-weight returns. By using small grazing units when the experimental area is limited, with sheep instead of cattle, animal variation can be overcome as numbers can thus be increased. Sheep results, however, may not be directly applicable to cattle. Differences in returns due to changes in stocking rates throw into focus the need for information as to the greatest

amount of herbage and of animal production that is possible within a closed farm system.

(4) Under a cutting treatment , without animal returns , the supplemental value of clover in Britain has been estimated at 105 lbs. of nitrogen per acre. Under grazing conditions it is quite possible that this figure will need to be adjusted. This provides scope for further study.

(5) There was evidence of a greater per day live-weight increase on a pedigree than a commercial sward (Jones , 1932, Blaser , 1956). Over a season ryegrass gave better spring and autumn production than cocksfoot, which produces good summer feed ; together they form a useful grazing unit. Differences between commercial and pedigree swards under similar treatment thus render comparisons between them justifiable in respect both of herbage and of animal returns.

(6) Both nitrogenous fertilisers and clover increase the total dry matter per acre of a sward. A reduction in yield both of clover and nodulation resulted when excessive amounts of nitrogenous fertiliser were added to the clover sward. A figure of 4 cwt. per acre Nitro-Chalk has been recorded as the maximum amount that would cause no reduction of the clover. There is need to know not only the optimum level of nitrogen for a clover sward , but also the sward and clover percentage in the sward that will give the greatest live weight for various types of stock.

(7) Animal selection of herbage and type of stock have some influence on sward development ; dung and urine returns also influence the dominance of grass or clover . They also affect nodulation.

(8) The amount of root mass under a sward reflected in percentage carbon (or organic matter) increases with age of the sward. The nitrogen percentage also increases with the clover content. Organic matter develops

sharply in four to five years then remains constant. There is greater root development under a pedigree than under a commercial sward , which suggests that greater potential fertility exists under the former.

(9) Because moisture in herbage is so variable , comparisons of yield are best made on a dry matter basis. The need for sampling below the height of grazing is also evident ; ground level sampling is ideal for experiments involving sheep.

(10) Greater sampling efficiency can be obtained by reducing the sample size (with an accurate area cut) and increasing the number of cuts (Green , 1949). Damage due to poor recovery of the sward and weed invasion is also reduced in this way. It also admits of a wider range of sampling without increasing the total area sampled.

(11) Protection of areas by cages for anything but short periods causes an increase in growth of as much as 11 per cent dry matter.

(12) Differences in amount of rumen and gut content cause errors in the estimation of live-weight gains. Weights can be ascertained more accurately after overnight fasting or by weighing three hours after sunrise when fill variations are at their lowest.

(13) Intake estimates with grazing animals can form a useful adjunct to the assessment of herbage by the use of faecal components (nitrogen and normal acid fibre especially) which have been shown to indicate differences of $\pm$ 5 per cent (Minson , 1958).

(14) The review shows that soil studies are useful , as are botanical and chemical comparisons of herbage , in the understanding of field experimental data involving the grazing animal. Such information may however have little direct application to farming practice.

OUTLINE OF EXPERIMENTS

3. OUTLINE OF EXPERIMENTS

1. EXPERIMENT 1. PUGDOWN 1. H 138

This experimental area (9 acres) and its surrounds (Figure 1 below) was grazed during its seeding year with cattle and sheep for establishment of the sward.

Figure 1. Plan of Pugdown 1. H 138

Danish +Ac 48	Irish +Ac 47	S.24 +Ac 46	S.37 +Ac 45	S.37 44	S.24 43	Irish 42	Danish 41
Danish +Ac 33	Irish +Ac 34	S.24 +Ac 35	S.37 +Ac 36	S.37 37	S.24 38	Irish 39	Danish 40

S.37 +Ac 32	S.24 +Ac 31	Danish 30	Irish 29	Danish +Ac 28	Irish +Ac 27	S.24 26	S.37 25
S.37 +Ac 17	S.24 +Ac 18	Danish 19	Irish 20	Danish +Ac 21	Irish +Ac 22	S.24 23	S.37 24

Danish +Ac 16	Irish +Ac 15	S.24 14	S.37 13	Irish 12	Danish 11	S.37 +Ac 10	S.24 +Ac 9
Danish +Ac 1	Irish +Ac 2	S.24 3	S.37 4	Irish 5	Danish 6	S.37 +Ac 7	S.24 +Ac 8

The experiment started in April , 1957 after fencing off individual plots ; the area was rotationally grazed with yearling half-bred ewe lambs , brought in from Scotland during October , 1956. These were drafted off in October, 1957 and replaced by a new and similarly constitued batch of half-bred ewe lambs. The procedure was repeated in the autumns of 1958 and 1959 , the object being to study the growth of ewe lambs through the year prior to breeding. Seed mixtures are given below :-

Species	Commercial Varieties lb/acre		Pedigree Varieties lb/acre	
With white clover				
Perennial ryegrass	Irish	15	S24	15
White clover	S100	1½	S100	1½
Wild white clover	S184	1½	S184	1½
Cocksfoot	Danish	15	S37	15
White clover	S100	1½	S100	1½
Wild white clover	S184	1½	S184	1½
Without white clover				
Perennial ryegrass	Irish	20	S24	20
Cocksfoot	Danish	20	S37	20

The experiment is laid out in randomized block form , there are 48 sub-plots each 3/16 acre in size ; the main treatment plots are ¾ acre each. Each of the three blocks consists of 4 main ¾-acre plots of either commercial or pedigree grass sward sown with or without white clover. S100 and S184 white clover are sown together in equal amounts in the grass-clover swards. Each main plot is further split for two species - perennial ryegrass (either S24 or Irish) and cocksfoot (either S37 or

Danish) in the following fashion :-

(1) Commercial grasses + nitrogenous fertiliser (perennial ryegrass-(Irish) cocksfoot (Danish)

(2) Commercial " + white clover (perennial ryegrass-(Irish) cocksfoot (Danish)

(3) Pedigree " + nitrogenous fertiliser (perennial ryegrass-(S 24) cocksfoot (S 37)

(4) " " + white clover (perennial ryegrass-(S 24) cocksfoot (S37)

Advantage is taken of the seasonal production differences of perennial ryegrass and cocksfoot in this experiment to form a grazing unit per se ; that is each $\frac{3}{4}$- acre unit forms a closed grazing unit. Grazing takes place on each of the four 3/16-acre areas in such a way that all ryegrass or cocksfoot swards on the same side are grazed at the same time whenever this is possible. This allows not only a basic pedigree-commercial comparison but also a clover-no clover comparison since utilisation is contemporary . Unfortunately due to differences in feed supply on the clover and no-clover swards it was not possible to maintain grazing of these swards in step throughout. In any event the basic pedigree-commercial comparison was always maintained on all replicates within clover and nitrogen treatments separately.

Apart from nitrogen in the complete fertiliser , (40 lbs. N , 40 lbs. P_2O_5 , 50 lbs. K_2O per acre) applied to all plots , no inorganic nitrogenous fertiliser was applied to the grass-clover plots , applications made to the all-grass plots being designed to replace the clover nitrogen. An average of 122 lbs. N per acre was applied in 1958. Some plots received 104 lbs. per acre and others 139 lbs. per acre. The areas protected for

cutting received the fertiliser dressing with the rest of the plot. Fertiliser was applied at follows :-

1958
LBS./ACRE

	(I.C.I.) - N	P_2O_5	K_2O	(Nitro-Chalk) - N	
April	27	27	34	35	
May				35	
June				35	
July	13	13	17	35	($\frac{1}{2}$ area)
	40	40	51	122	

1959

March	27	27	34	35	
April				35	($\frac{1}{2}$ area)
May				35	"
July	13	13	17		
August				35	"
	40	40	51	88	Av.

This experimental site is exposed and slopes gently to the west and sharply to the north. The soil is not unduly variable , but drainage becomes freer from south-east to north-west from a slightly clayey to an area more freely drained and rich in lime : drainage on the entire site is good. The soil depth varies between 8 and 18 inches.

11. EXPERIMENT 11. CHAPEL FIELD 1 and 2 - H15

The second experimental area H15 involved 2 (and 3 in 1959) of 10 plots of a total area of 35·5 acres which is maintained as a closed farm unit providing all-the-year feed for cattle (steers) and sheep. The area was originally sown to a number of seed mixtures in 1950 and various plots have since been ploughed and re-seeded as soon as production declined. Details of the first six years of this trial have been reported by Alder (1955) and Alder and Redford (1958).

Latterly it was decided to maintain the same closed unit system and also embrace a comparison of commercial and pedigree varieties of each species. This was done by dividing each plot into two halves , planting out the "A" half to a pedigree and the "B" to a commercial variety of the same species. The animals grazing the different varieties were kept exclusively on either pedigree or commercial swards. The plots (3 A and B and 7 A and B) studied in 1958 were planted with Italian ryegrass (S 22 and Irish) without any legume and received generous dressings of nitrogenous fertilisers during the year. (Plot 3 received 124 lbs. N., 54 lbs. P_2O_5 , and 67 lbs. K_2O : Plot 7 - 197 lbs. N., 40 lbs. P_2O_5 and 50 lbs. K_2O).

In 1959 plots 5 , 7 and 8 were ploughed up and re-seeded , plot 7 between April , 6 and 8 and plots 5 and 8 on April ,22 ; these were studied during that year . Plot 5 was sown to S 22 and Danish Italian ryegrass (5A and 5B respectively) , plot 8 was sown with S 22 and Irish Italian ryegrass (8A and 8B respectively) , while plot 7 was sown to S 170 and Oregon Certified Alta tall fescue (7A and 7B respectively) with New Zealand white clover broadcasted at a seed rate of $2\frac{1}{2}$ lbs. per acre. Seed rate with the Italian ryegrasses on plots 5 and 8 was 20 lbs. per acre while sub-plots 7A and 7B were at a seed rate of 8 and $8\frac{1}{2}$ lbs. per acre tall fescue respectively.

Plots 3 and 8 cover an area of 3.6 acres while plot 5 is 3.4 acres and plot 7 is 3.7 acres. The areas of each sub-plot at each sowing are shown in the table on page 32 while Figure 2 gives a plan of the entire site with the positions of cages shown for both years.

PLOT NO.	SOWN SPRING 1957	UNDER-SOWN RYE AUTUMN 1957	SOWN SPRING 1958	SOWN SPRING 1959
3A (1)		S.22 0.96ac.		
3B (1)		Irish 0.76 "		
3A (2)			S.22 0.84ac.	
3B (2)			Irish 1.06 "	
7A	S.22 1.9ac.			
7B	Irish 1.8 "			
5A				S.22 1.7ac.
5B				Danish 1.7 "
8A				S.22 1.8 "
8B				Irish 1.8 "
7A				S.170+Ac. 1.85 "
7B				Alta+Ac. 1.85 "

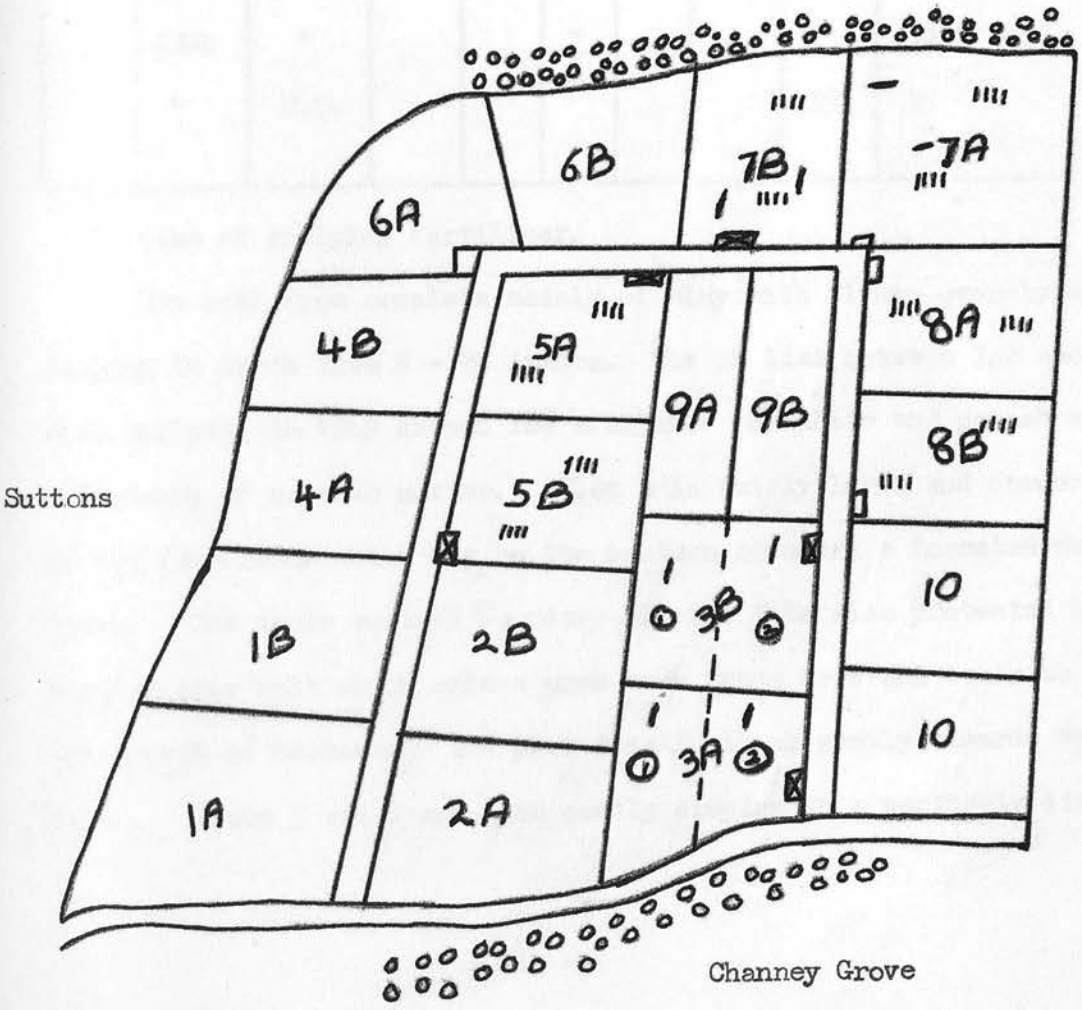
Plot 3 was sown with rye in the autumn of 1957 for early spring grazing ; part of sub-plot A and B , referred to here as 3A (1) and 3B (1), were under-sown in November ,1957 with S.22 and Irish Italian ryegrass respectively. The remaining portions of sub-plots 3A and 3B , referred to as 3A (2) and 3B (2) , were sown in April ,1958 after the rye had been grazed off by sheep. Both plots were drilled at a seed rate of 20 lbs. per acre.

Both sheep and cattle , either separately or together , grazed the plots as feed became available. Fertiliser application to all plots are shown below. Respective sub-plots received similar treatment ;

fertiliser application , mowing ,and grazing being carried out simultaneously , so that a comparison between commercial and pedigree varieties was always maintained. Below is a plan of the experimental site.

FIGURE 2. H 15 CHAPEL FIELD 1 and 11

– Caged Sites -1958
"" " " -1959



Fertiliser application are shown below :-

YEAR	PLOT	FERT.	SEPT.	FEB.	APR.	MAY	JUNE	JULY	TOTAL LBS./ACRE N.	P_2O_5	K_2O
1957	3A&B	I.C.I.	〃						54	54	67
1958	〃	N.C.			35			35	70		
〃	7A&B	I.C.I.			〃				40	40	50
	〃	N.C.		52		35	35	35	157		
1959	5A&B	I.C.I.			〃				40	40	50
	〃	N.C.						35	35		
	7A&B	I.C.I			〃				40	40	50
	8A&B	〃			〃				40	40	50
	〃	N.C.						35	35		

〃 time of applying fertiliser.

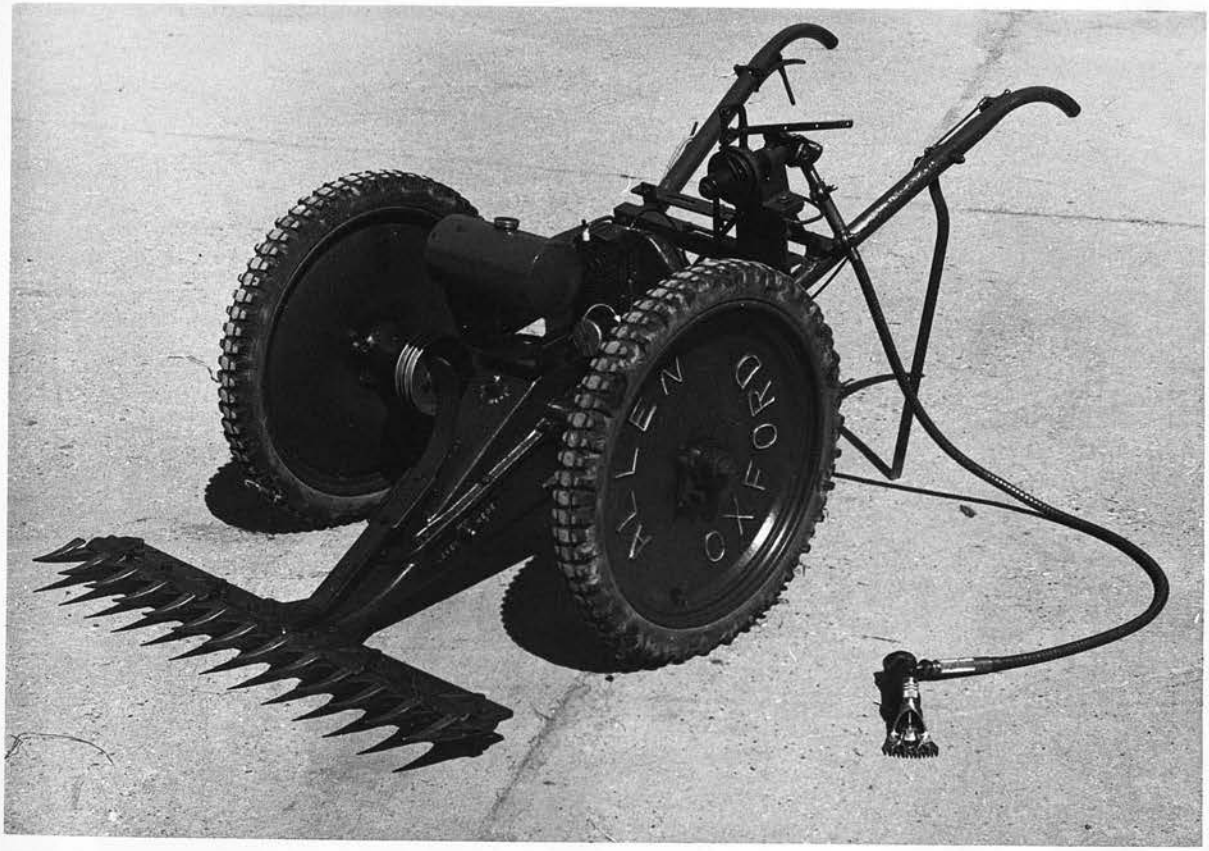
The soil type consists mainly of clay with flints over-lying chalk , ranging in depth from 6 - 24 inches. The pH lies between 7.0 and 8.0 and soil analysis in 1949 showed low available phosphate and potash and a deficiency of organic matter. Plot 3 is fairly level and borders one of the farm roads which has on its eastern boundary a forested belt of trees. The whole western boundary of plot 7 is also protected by a similar tree belt which offers much more shade here and tends to influence the growth of herbage. The plot itself slopes gently towards the north-west . Plots 5 and 8 are also gently sloping in a northerly direction.

111. METHOD OF INVESTIGATION

A. Herbage sampling techniques

Herbage yields were measured (Appendix 1) , under grazing and no-grazing , the latter on areas protected by cages during grazing. Yields of each plot were assessed before the animals were introduced : samples 6 feet by 3 inches were cut to ground level with a sheep shear used by other workers (McLusky , Ph.D. Thesis , Line , 1958). The shear itself was driven by direct drive from the power take-off of an Allen Auto-scythe (Figure 3 below).

FIGURE 3. ALLEN AUTO-SCYTHE FITTED WITH SHEEP SHEAR



A clutch is fitted between the 6-foot long flex and the pulley so that the shear can be switched on and off as required.

(a) Out Samples

In experiment 1 , 20 samples were taken per plot or 30 square feet sample area ; on experiment 11 , 20 samples were taken on each 4 sub-plots of plot 3 and 40 on each 2 sub-plots of plots 5 , 7 and 8. Equal numbers of samples , 5 or 10 , were taken from each quarter of each sub-plot to overcome the normal variation in yield of herbage. No attempt was made , apart from the periods when intake studies were undertaken , to do after-grazing sampling because of the length of time the animals were grazing the plots (from 7 to 14 days) and because the herbage growth taking place during these grazing periods was not measured. The after-grazing sampling done will be discussed in connection with the respective intake studies.

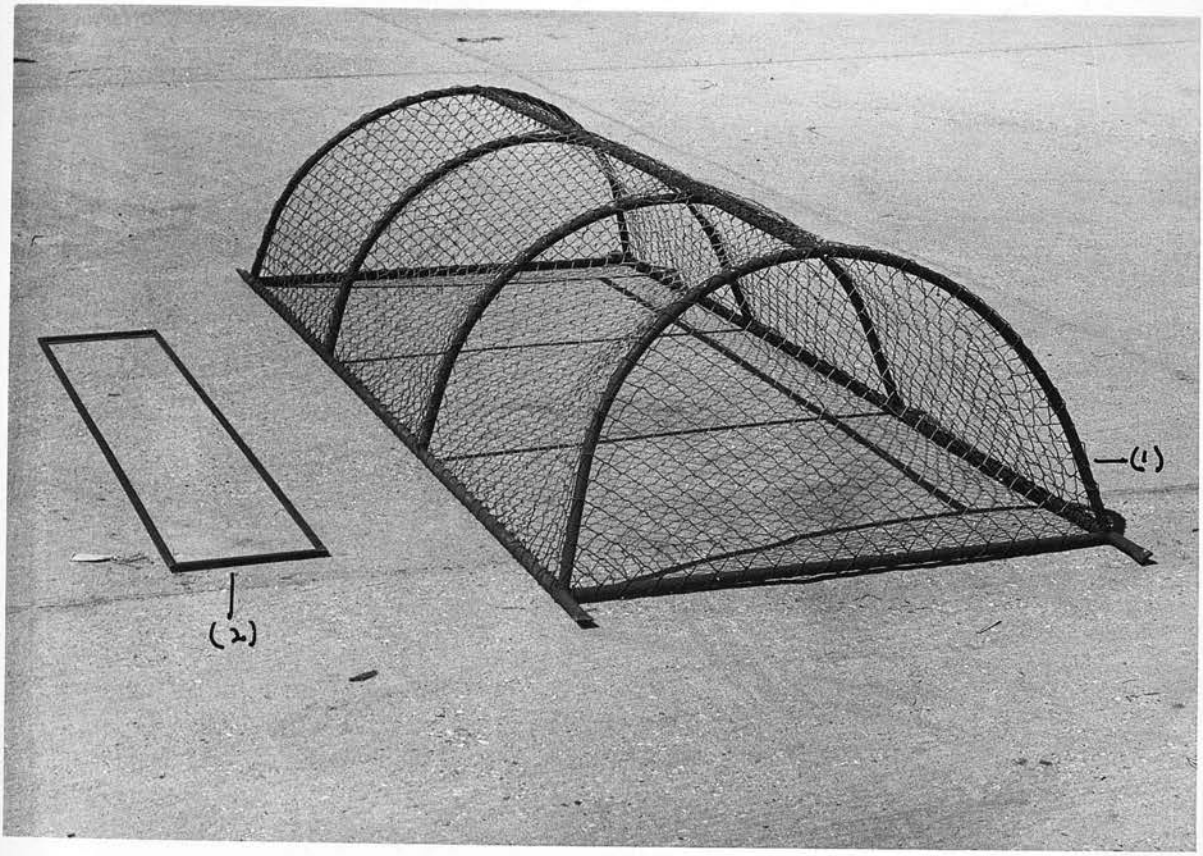
The pre-grazing samples gave a relative comparison of the amount of herbage on offer at the commencement of each grazing. The pre-grazing cuts will be prefixed by the letter "O" to distinguish them from the caged cuts which will bear the letter "C" instead.

(b) Caged Samples (1958)

Due to the close cutting practised and the height of the cages , which were similar to those used previously by Williams and Cowlishaw (1951) shown in Figure 4 (1) and as there was no information on the nature of the recovery likely to be expected from such treatment , it was decided to have three areas which could be accommondated under the cage , allowing for marginal discard. A 3-weekly sampling interval was practised thus allowing fair recovery of the herbage. Sampling was done with the aid

of a six foot by one foot metal quadrat (Fig.4 (2)) and it was so arranged that each of the three sites were sampled once every 9 weeks with an additional topping with the Allen every 3 weeks at sampling. Cages are on the plots only while animals are grazing.

FIGURE 4. CAGE USED IN 1958 WITH QUADRAT (6' x 1')

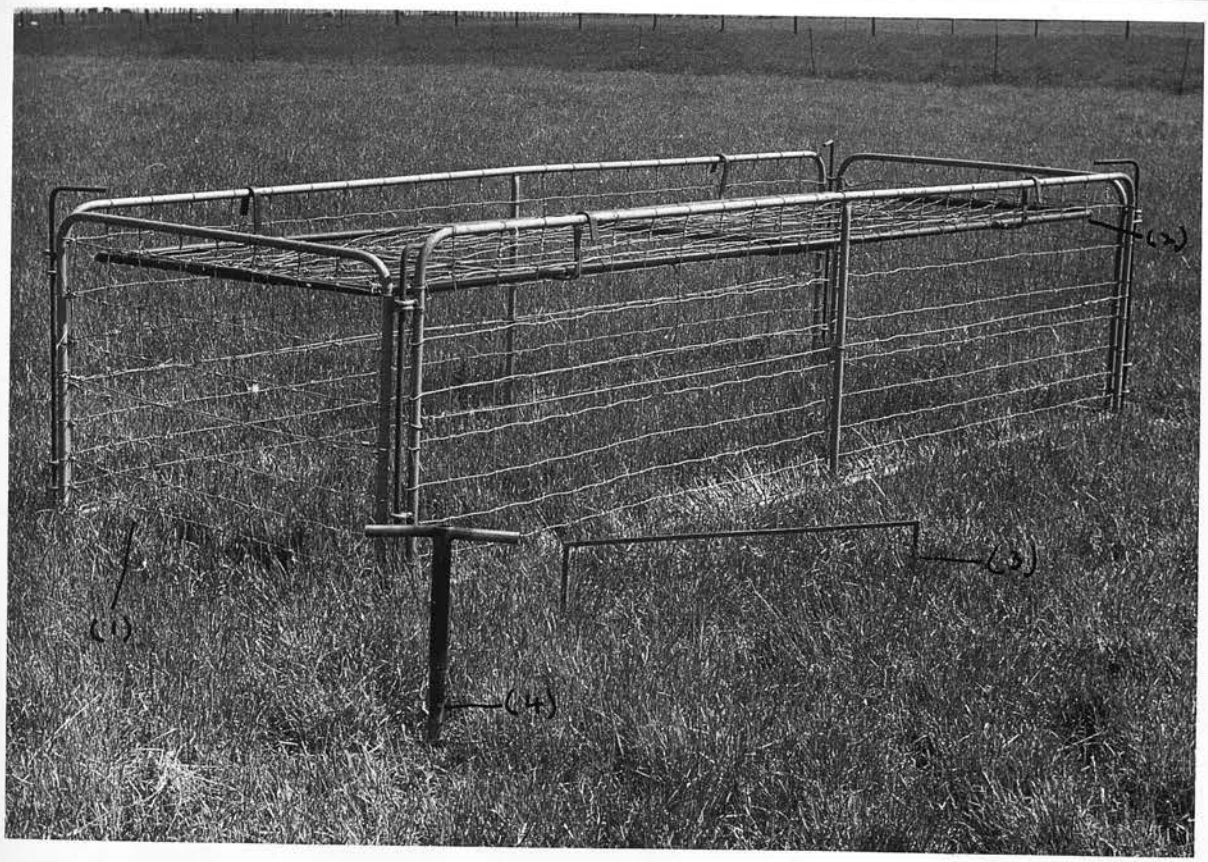


(c) Caged Samples (1959)

In addition to the method already used , in 1959 on block 1 of experiment 1 another type of cage was used to enclose an area 12 feet by 4 feet (Fig. 5 (1)) instead so as to provide another site 4 feet by 4 feet from which 3 feet by 1 foot cuts could be taken by the use of another

quadrat (Fig. 5 (3)) where no topping was done by the Allen. Only these new cages with tops (Fig. 5 (2)) were used in experiment 11 and this new technique alone was employed on the tall fescue swards on plot 7. On swards with S 22 and Irish Italian ryegrass both methods were employed.

FIGURE 5 - NEW CAGE USED IN 1959 WITH TOP , QUADRAT (3' x 1') AND SOIL CORER



B. Method of dry matter Estimation and Preparing Samples for Botanical and Chemical Analysis

Herbage from each plot was weighed as soon as possible after removal from the field on an August-Sauter balance capable of weighing to a maximum of 2.4 kilograms. Care was taken to separate and remove as much soil as possible from the herbage before weighing. A sub-sample of 200 to 400 grams or at times less , depending on the yield , was taken for dry matter determination . The sample was dried in a hot air draught oven at 100 degrees centigrade for 24 hours , weighed and the total plot dry matter yield determined. This was later converted to pounds per acre. The dried herbage was then ground in a mill for chemical analysis. A similar sample of green herbage , as for dry matter determination , was taken for botanical analysis separation being done for burn and green herbage , the latter being further divided into leaf , stem , clover (when sown) , other grass (unsown species) and other species (including clover when not sown). In experiment 1 the 1957 treatment had resulted in quite a deal of "foggage" accumulating on the northern half of the plot in 1958, so that botanical separation included estimation of "burnt" herbage. This foggage did not appear to have affected yield appreciably and it disappeared by summer. This estimation was continued throughout , and cages were placed at random on northern half of the plots only and not alternating at random between north and south.

Herbage collected in 1958 was bulked into four lots (corresponding with the stage of growth and to some extent the utilisation by stock). A similar procedure was adopted in 1959 keeping the dates for each bulking as closely as possible to the previous year. Periods for

both years are as follows :-

1958

Period	1	April , 1	- May ,20	Spring herbage to early seeding
"	2	May ,21	- June,24	Full-seed stage before topping
"	3	June, 25	- September,1	Summer growth
"	4	September, 2	- November,11	Autumn growth to winter pause

1959

Period	1	March, 31	- May , 11	Spring herbage to early seeding
"	2	May , 12	- June , 2	Full-seed stage before topping
"	3	June , 3	- August ,25	Summer growth
"	4	August ,26	- October,26	Autumn growth to winter pause

In both experiments , although the dates of utilisation are not the same for cuts both under grazing and under cages , bulking fell within this general pattern. The bulking was done on a plot basis within each period.

Yields for hay and silage in experiment 1 were not estimated by this technique with the sheep shear due to the lodging likely to occur and the resultant difficulties in reaping. Instead two 6 foot by 3 foot sample ares were cut with the Allen auto-scythe to estimate yields , a sub-sample being taken for dry matter estimation. Chemical analysis for percentage nitrogen (Appendix 2a) and ash (Appendix 2b) were carried out , the first to give a measure of the quality of the herbage at each period and the second to give a measure of the soil contamination encountered and ash values of herbage cut at ground level.

C. Soil Sampling

Soil sampling of each plot was done in experiment 1 in mid-February , 1958 and again at the end of the experiment in autumn ,1959. Sampling was done in early March ,1958 , in experiment II on plots 3 and 7 and again in November ,1958 as work on these swards was completed. In 1959 plots 5 , 7 and 8 in experiment II were sampled in spring and again in autumn ; twenty 1-inch diameter cores 3 inches deep were taken on each sub-plot in experiment 1 while 20 and 40 on sub-plots 3 and 7 respectively in experiment II were taken. Forty were also taken on plots 5 and 8 . The corer (Fig. 5 (4)) is that used and found to be satisfactory at the Grassland Research Institute , Hurley. The depth of three inches is similar to that used by Metson and Hurst (1953) and was considered to be a satisfactory depth for comparative study over a short period.

D. Criticism of Herbage Sampling Techniques

(a) "Out"Samples

Samples in the open plots were taken using the sheep shear which has an effective width of cut of three inches ; with the aid of a straight edge each cut is sampled 6 feet long thus giving an area of $1\frac{1}{2}$ square feet for each cut. It is possible to veer from the edge and not to cut the exact 6 feet but with suitable precautions the method is accurate. No difference in variability was found between 31 samples taken by this method on a perennial ryegrass sward in February ,1958 and that within paired one-foot-by-one-foot quadrat samples taken at the same time (Appendix 3).

(b) Caged Samples

Only one site for cages was chosen on each sub-plot in experiment 1 and sub-plots of plot 3 in experiment II . It is felt that the respective areas gave a satisfactory yield estimate of each plot ; the replicate sample yield was , however , used for comparison. The small area used may be criticised but this was partially overcome by having three 6 foot by 1 foot sites within the cage for sampling in turn. The alternate strips also prolonged the life of the sward so cut, as it would not last long if the entire area were cut to ground level every three weeks. Topping-over the caged area was unfortunately found necessary, for if left for 9 weeks herbage would grow through the cages and be eaten by stock. The topping back of the entire area every three weeks caused a loss of information as the toppings were not collected and weighed. A relative yield comparison was obtained rather than total yield. Although this technique was continued in 1959 , some cages were modified to allow for an additional area on block 1 in experiment 1 where no topping back would be needed. The total herbage growth was collected from these new sites over the period. In experiment II the new modification only was employed in 1959 , except on plots where S22 or Irish Italian ryegrass swards were being compared.

With this method of sampling all the herbage yielded is cut to ground level so that even slight depressions on the soil surface do not cause variations in the height of cut above ground. It is, however , possible and indeed very easy to cut samples below ground level and thereby increase soil contamination and impede recovery. As bad weather does not prevent the use of this equipment samples can be collected regularly. It is also possible to start sampling earlier in the season and finish later , since smaller amounts of herbage can be measured . The 3 inch width of cut is

advantageous because a long cut is taken and variations in the sward are therefore more adequately covered (Green , 1952). By this means animals cannot possibly graze below the height of sampling. Soft , leafy herbage is adequately cut if the equipment is satisfactorily maintained.

E. Comparison of Cutting Methods and Recovery of Herbage

(a) Herbage Yield Estimation

During 1959 , a comparison of herbage yields by four different methods was undertaken. On the first occasion the three methods studied were a 6 foot by 1 foot quadrat sampled with a sheep shear , four 6 foot by 3 inch samples cut also with a sheep shear and a 6 foot by 1 foot area also , sampled with a Tarpen. The residue from the Tarpen site was cut to ground level by the sheep shear . On the second occasion the first three methods were adopted as before along with two 3 inch by 3 inch turves for each 6 foot by 1 foot sample. The herbage on both turves were cut to ground level with a pair of scissors and bulked. Twenty adjacent sets of samples were taken on both occasions.

Another 100 pairs of samples were taken in the autumn comparing 6 foot by 3 inch with 6 foot by 1 foot samples. Yields were compared on organic matter basis after correcting for ash.

(b) Recovery of Herbage when using two Cutting Systems

A study was also made in 1959 of the recovery of herbage cut by means of a Tarpen (6 x 1 foot) and the sheep shear and quadrat (6 x 1 foot). The site was protected and three alternate sites were used and sampled as for the cage-sampling technique. Three replicates were used and there was no topping back after 3- weekly sampling.

F. Animal Intake Studies

(a) Experiment 1 H138 - 1958

Two separate estimates of herbage intake by the grazing animal (sheep) were carried out on one-half of the perennial ryegrass swards in block 1 during 1958. On both occasions the same four plots and the same four animals per plot were used with commercial and pedigree swards with and without clover. The availability of feed on the 3 blocks was vastly different ; and it was decided to use block 1 only , as there seemed to be adequate grass available for the entire period of the trial on it.

The studies were made between June 11 and 25 in the first instance and between August 29 and September 10 in the second. No herbage was available on either occasion for indoor digestibility studies. Such figures for digestibility as are used were supplied by Minson and Brown (1957 - 8) , for similar swards of comparable nitrogen content. Dosing took place each morning at 9:00 a.m. , each animal receiving 1.92 grams chromic oxide contained in two gelatine capsules . A 4-days dosing period was allowed before collection of faeces commenced. (See appendix 4 - (a) for method of collection) . Dosing continued until the day before the last day of collection.

The nine faecal samples collected on each occasion were bulked into three 3-day periods which were thoroughly mixed by an electric mixer before being sub-sampled. The samples were dried at 100 degrees centigrade for two days and ground for chemical analysis - nitrogen , ash , chromic oxide and normal acid fibre (Appendix 2 a - d) .

(b) Experiment 1 H 138 - 1959

The same 4 sub-plots were used as in 1958 - (a) above - and the same techniques adopted for the two determinations between June 4 and 17 and July 30 and August 12.

(c) Experiment 11-H 15 - 1958

During 1958 two intake estimates were carried out on sub-plots A and B of plot 7 . The same two groups of five animals were used on both occasions . Yearling cattle , between 11 and 15 months old in July , were dosed daily with 10 grams chromic oxide enclosed in one gelatine capsule. The sampling of faeces is outlined in Appendix 4 - (b).

Two estimations were made between July 14 and 25 and between October 20 and 31. Dosing started four days before collection as before , and continued to the penultimate day of collecting faeces. The collections were this time kept separate for daily estimations. Samples for chemical analysis were prepared as above.

Herbage samples for indoor digestibility trials were cut on both occasions from both sub-plots ; and the necessary dry matter and chemical determinations were carried out , as they were for faeces.

Appendix 4 - (c) gives methods used for calculating faecal organic matter output and digestibility of herbage for experiments 1 and 11.

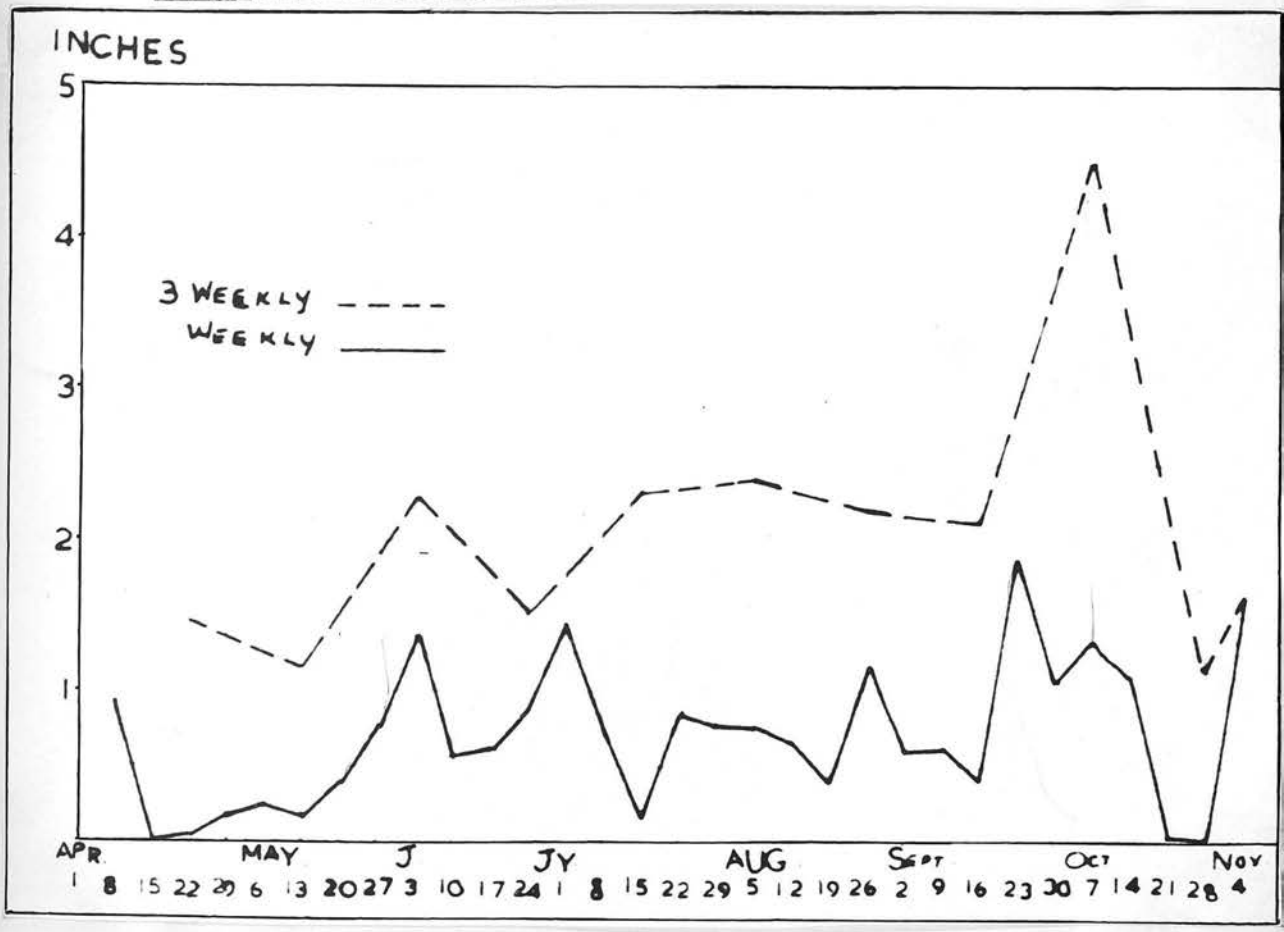
RESULTS - 1958

4. RESULTS - 1958

1. Weather

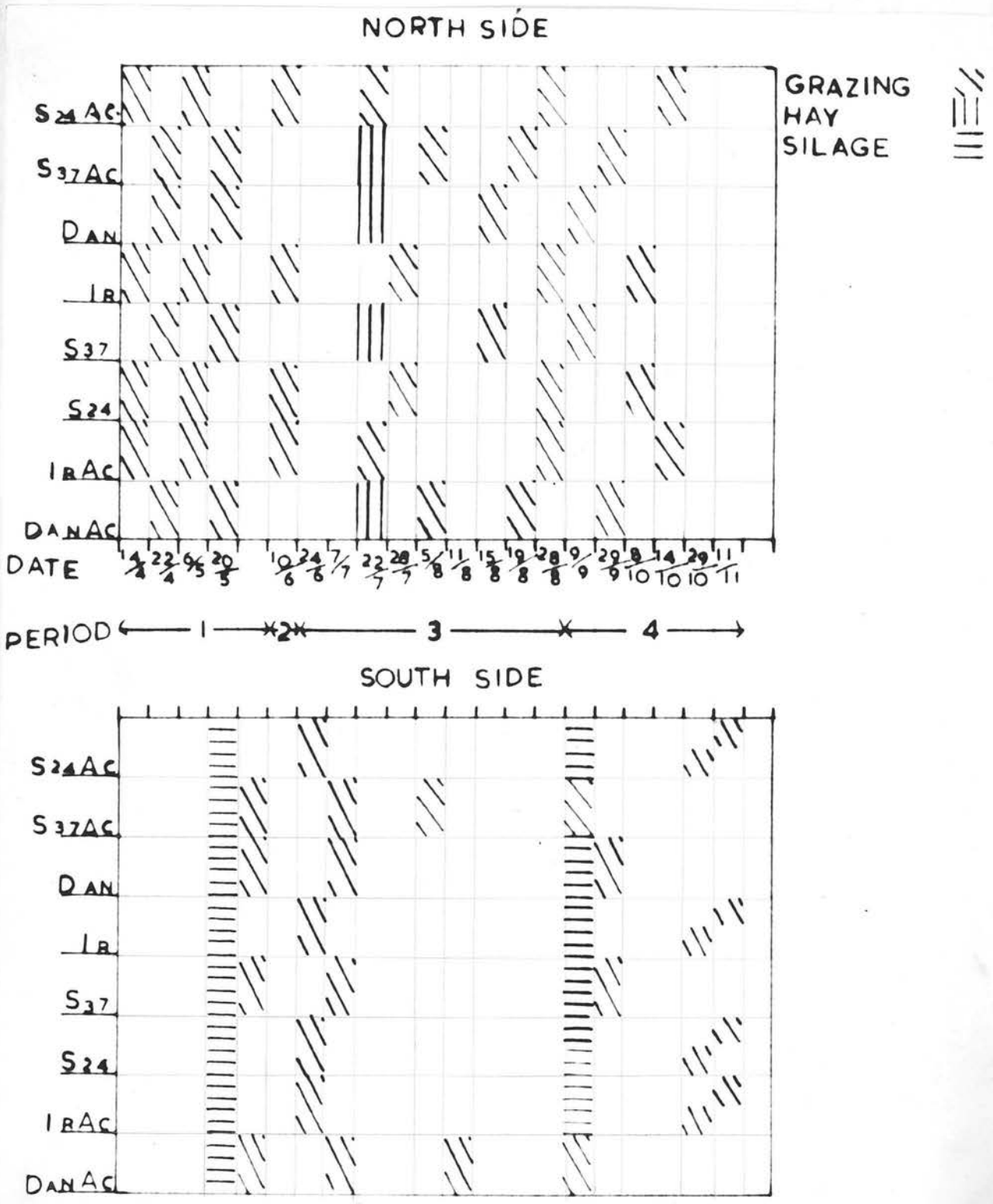
The weather during the year favoured the growth of grass. From April 1 1958 to November 4 , 1958 a total of 21.50 inches of rain fell , as compared with the previous year when 14.24 inches were recorded. This increase of 7.26 inches was similar to the increase over the average figure for the previous ten years. The season was rather late and in order to allow a fair amount of growth on the perennial ryegrass plots in experiment 1 , grazing did not begin until April 16. It was possible to utilise the Italian ryegrass plot 7 in experiment 11 earlier , and, grazing by sheep started on April 11. Figure 6 shows rainfall recorded at weekly and 3-weekly intervals over the period .

FIGURE 6 - RAINFALL -1958



17. Experiment 1 - Pugdown 1 - H 138

FIGURE 7 HERBAGE UTILISATION -1958



A. Herbage Utilisation

Figure 7 (page 47) shows the time of utilisation of the different plots both when grazed and when cut for hay and silage. The division into four periods is based on the stage of maturity of the herbage , and samples of the same plot, falling within the same period , were bulked for chemical and for botanical analysis , as it was not felt that any useful information was lost. The four periods were :-

Period	1	April 14	to May 20
"	2	May 21	" June 10
"	3	June 11	" September 9
"	4	September 10	" November 11

At the beginning of the season the "northern-half" plots were used for grazing while the "southern-half" were shut up for silage and aftermath grazing. Between April 16 and May 20 grazing alternated between the four perennial ryegrass plots and the adjacent cocksfoot plots . Two grazings were taken from each within period 1. Silage was cut from the southern half plots between May 19 and 21 . Only perennial ryegrass was grazed in period 2 ; the cocksfoot plots were left up for hay , which was cut on July 14.

The "northern-half" plots continued to be grazed for the rest of the year . Apart from another cut of silage on all the "southern-half" plots, except cocksfoot-clover , on September 4 , they too were grazed for the remainder of the season. After only twelve days recovery the first aftermath cocksfoot silage plots on the "southern-half" were grazed for one week by the stock (June 4 to 10) largely to clear up herbage inefficiently reaped. No sampling was done on this occasion as very little herbage was available for it.

FIGURE 8. PLOT DRY MATTER (x 100 lbs.) - '0'

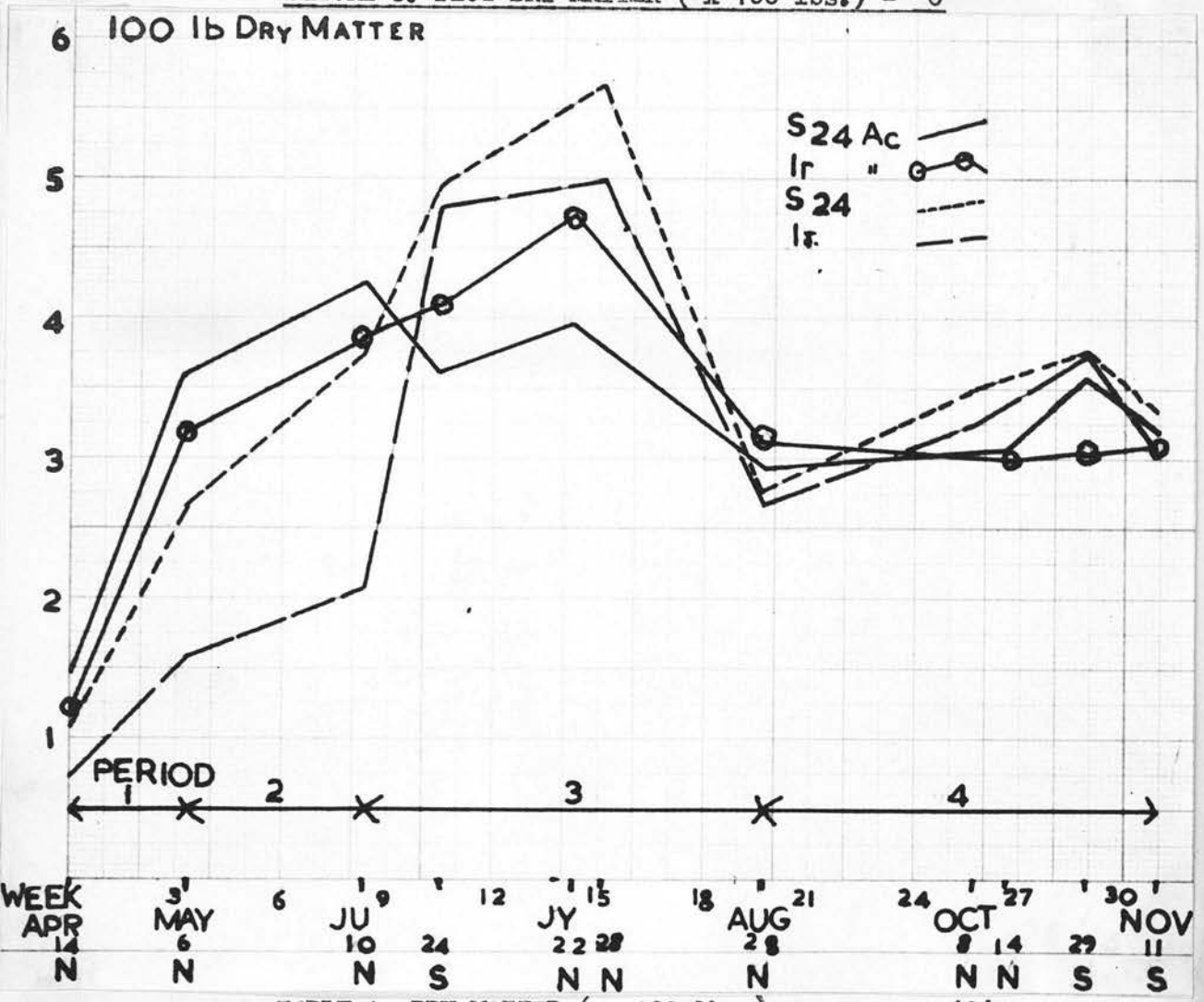


TABLE 1. DRY MATTER (x 100 lbs.) per acre - '0'

Period	Plot	Cor. D.M./ac	White clover	Sown grass	Other grass	Other weeds
1	S24 Ac	27	2	22	3	
	Ir Ac	23	3	16	4	
2	S24 Ac	23	2	20	1	
	Ir Ac	21	2	16	3	
3	S24 Ac	56	13	39	3	1
	Ir Ac	64	22	30	11	1
4	S24 Ac	52	9	39	4	
	Ir Ac	49	10	25	14	
Total	S24 Ac	158	26	120	11	1
	Ir Ac	157	37	87	32	1

After July 7 , it was not possible to maintain the grazing together of grass-clover and no-clover plots , because of great differences in herbage yields which did not obtain on two occasions , August 28 , and between October 29 and November 11. On the latter occasion plots were strip-folded (half plot at a time) . Yields per acre quoted in the following figures cannot be taken as absolute because they were taken from the north and south halves of the plots or from different sites within the cages at various periods. Sampling was also not on the same area under grazing , and as cutting height was below the level of grazing , this will also tend to inflate seasonal and annual yields. At the same time the figures can be taken as relative and it is on this basis that they are quoted.

B. Perennial Ryegrass

(a) Yields under grazing ' 0 '

Figure 8 (page 49) shows the total amount of herbage dry matter available on grass-clover and pure grass plots for each grazing. In this instance , as in all others when not otherwise specified , yields were corrected for burnt material and soil contamination , calculated after botanical analysis of samples. Each value reflects the average treatment yield for that date.

1. Grass-clover

Table 1 (page 49) gives the total dry matter yield of herbage and of each constituent for each period during the year in 100 pounds dry matter per acre. At all periods except the third , the pedigree swards out-yielded the commercial , while the amount of both white clover and other grasses were greater in the commercial swards at all periods of the year. For the whole year the pedigree swards had nearly 37 per cent more perennial ryegrass than the commercial plots with nearly 40 per cent more

clover and nearly 300 per cent more other grasses on the commercial than the pedigree swards. Other grass species were mainly annual meadow grass (Poa annua) and Agrostis species. The total annual yield was 100 pounds in favour of the pedigree which was not significant. Analysis of variance is shown in Appendix 5 (a) with yields at each sample.

Table 2 gives total yields and standard error for the year.

TABLE 2. DRY MATTER (x 10 lbs.) - MEAN YIELDS AND STANDARD ERROR - '0'

Period	S24 Ac	Ir Ac	S 24	Ir.	S.E. of means of 3
1	2650_{+}^{++}	2340^{++}	1990_{+}	1240	± 199
2	2660^{+}	2050^{+}	1990	1100	± 255
3	561.0	639.0	-	-	± 23.0
4	524.0	486.0	-	-	± 22.0
1-4	1580	1560	-	-	± 35.0

\+ 0.05 level significance

++ 0.01 " "

Table 1 also shows that during period 3 the higher yield of the commercial was due to the greater proportion of clover in the sward (33 as against 21 per cent) , which reached maximum growth at that time. The differences in favour of the commercial in period 3 and of the pedigree in period 4 were not significant , Table 2. Analyses of variance are in Appendix 5 (b and c).

There was a significant difference between clover and no-clover treatments in period 1 at the 0.01 level of significance and in period 2

at the 0.05 level in favour of the clover treatment ; in period 1 there was also a 0.05 level significance in favour of the pedigree swards (Appendix 5 - d and e) .

2. "Pure" grass

Table 3 shows similar figures for the pure grass swards.

TABLE 3. DRY MATTER -(x 100 lbs.) per acre - '0'

Period	Plot	Cor D.M./ac.	Sown grass	Other grass	Other weeds
1	S 24	20	19	1	
	Ir	12	11	1	
2	S 24	20	19	1	
	Ir	11	7	4	
3	S24	71	63	6	2
	Ir	67	38	23	6
4	S 24	57	50	6	1
	Ir	54	33	19	2
Total	S 24	168	151	14	3
	Ir	144	89	47	8

Throughout the four periods the total dry matter on offer was higher on the pedigree swards , although the differences got smaller as the season progressed (Figure 8 , page 49). Other grasses and other species were more than 300 and 250 per cent greater respectively in the commercial than the pedigree : sown species were nearly 75 per cent more in the pedigree swards. The difference of 2400 pounds in favour of the pedigree plots for the year was not significant. Appendix 5 (f) gives full details of yields with analysis of variance. Table 4 shows total dry matter yields and standard errors.

TABLE 4. DRY MATTER -(x 10 lbs.) - MEAN YIELDS AND STANDARD ERROR - 'O'

Period	S 24	Irish	S.E. of Means of 3
3	714.0	666.0	± 24.4
4	565.0	534.0	± 35.8
1- 4	1680	1440	± 63.7

There was no significant difference in yields during periods 3 and 4 (Table 4 above - Appendix 5 g and h) . In spite of the large differences between pedigree and commercial plots in periods 1 and 2 (Table 3) they were not significant, due to the lower degrees of freedom for error and the higher 'F' value (18.51) needed for significance and also plot variability.

Pedigree swards were in both instances more persistent than commercial as is indicated by the amounts of weed grasses (Tables 1 and 3). Where a comparison between grass-clover and pure grass swards was possible over periods 1 and 2 there was significance between varieties at the 0.05 level in period 1 and between clover and no-clover at the 0.01 level in period 1 and in period 2 at the 0.05 level. The herbage yields on swards were higher on the pedigree swards with and without clover.

(b) Perennial ryegrass - 'C'

(1) Grass-clover

Figure 9 (page 54) shows yields of herbage dry matter collected from grass and clover swards.

FIGURE 9. PLOT DRY MATTER (x 100 lbs.) - ' C '

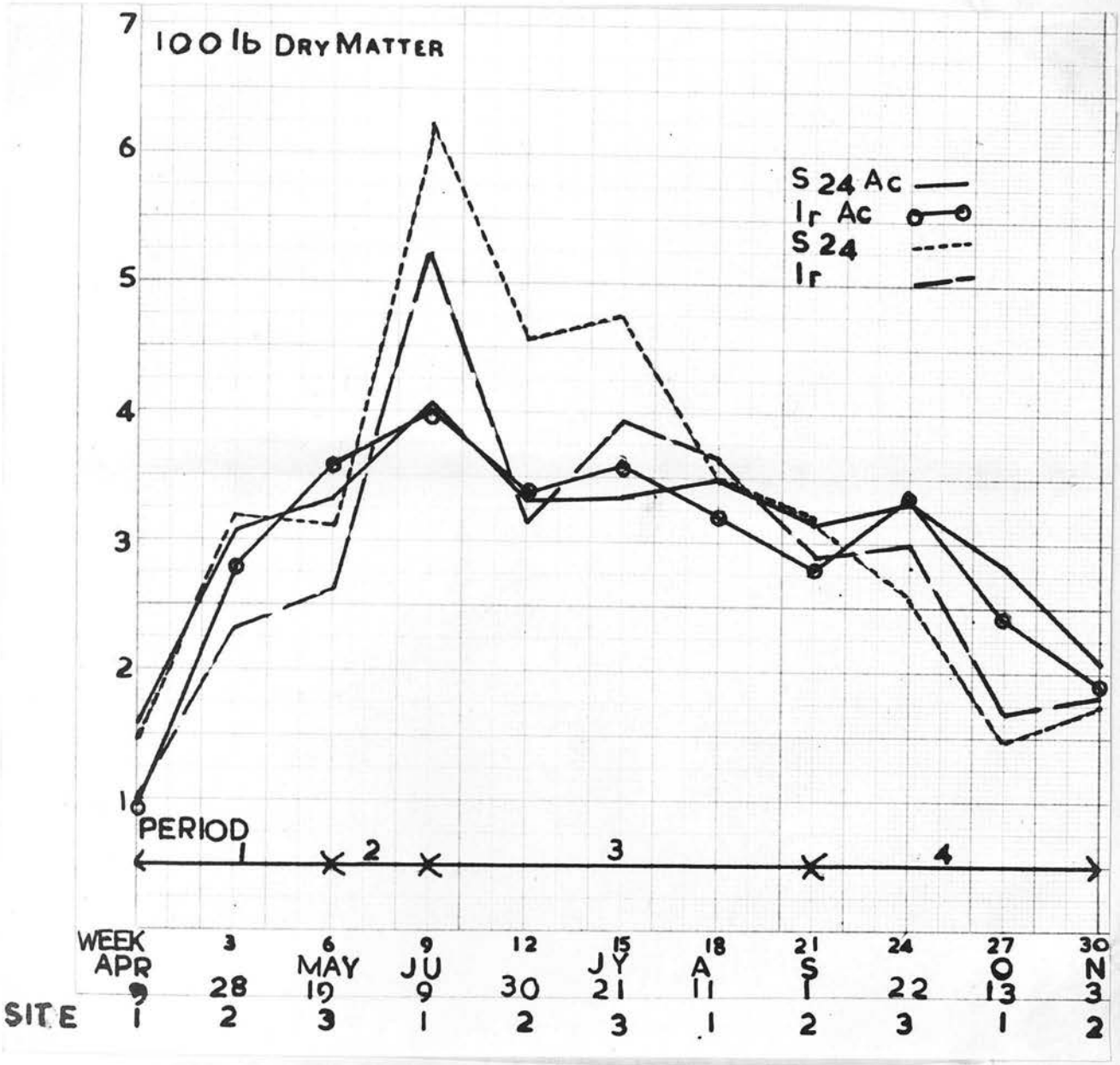


Table 5 (page 55) shows seasonal yields over the four periods. Over all periods the differences were in favour of the pedigree grasses : the overall total of over 800 lbs. was not significant (Table 6). The amounts of clover and other grasses were also greater on the commercial swards by 21 and 115 per cent respectively. Sown grass was more

than 39 per cent greater on the pedigree sward. Appendix 6 (a) gives yields at each sample date with analysis of variance.

TABLE 5. DRY MATTER - (x 100 lbs.) per acre - 'C'

Period	Plot	Cor. D.M./ac.	White Clover	Sown Grass	Other Grass	Other Weeds
1	S24Ac	42	6	33	3	
	IrAc	39	5	27	7	
2	S24Ac	22	6	15	1	
	IrAc	21	7	12	2	
3	S24Ac	71	25	38	5	3
	IrAc	69	32	27	8	2
4	S24Ac	43	6	33	4	
	IrAc	41	9	20	11	1
	S24Ac	178	43	119	13	3
Total	IrAc	170	53	86	28	3
1	S 24	41		39	2	
	Ir	32		22	10	
2	S 24	33		31	2	
	Ir	28		18	9	1
3	S 24	85		78	4	3
	Ir	70		44	26	
4	S 24	31		27	4	
	Ir	34		17	16	1
	S24	190		175	12	3
Total	Ir	164		101	61	2

TABLE 6. DRY MATTER - (x 10 lbs.)-MEAN YIELDS AND STANDARD ERROR-'C'

Period	S24Ac	IrAc	S 24	Ir	S.E. of Means of 3
1	425.0	390.0	414.0	317.0	± 27.0
2	216.0	213.0	332.0++	278.0++	± 19.8
3	707.0	691.0	852.0	698.0	± 43.2
4	436.0+	406.0+	308.0	345.0	± 27.0
1-4	1784	1700	1905	1638	± 88.2

\+ 0.05 level significance
++ 0.01 " "

Table 6 gives yields per period with standard error and the significant-level differences if any. During period 2 the nitrogen plots were superior at the 0.01 level and in period 4 clover plots were better at the 0.05 significance level. In period 2 this may be associated with the fact that the fertiliser nitrogen added was higher than that excreted by the clover ; this will be discussed later. At the same time the lowering of the clover proportion by the close sampling technique also helped to accentuate the difference.

During period 4 the difference could be due to the higher clover production at that time ; sown grasses on those swards were much greater than on the pure grass areas , and possibly too the fact that the nitrogen balance was now in favour of the clover plots as will be shown later in Table 11 , since no fertiliser was applied after August. Analysis of variance is shown in Appendix 6 (b - e).

(2) "Pure "grass

Table 5 (page 55) shows yields from pure grass swards during each period. S 24 outyielded Irish on all but the last period , but over the year the difference of 266 pounds in favour of S 24 was not significant. There was 70 per cent more sown grass on the pedigree swards while unsown grasses were nearly 500 per cent more on the commercial swards. Table 7 (page 57) gives the percentage contribution of the various constituents of the sward under grazing and under cutting on all ryegrass swards. Yields for each sample are shown in Appendix 6 (f).

On the clover swards sown species seem to have persisted to the same extent under both managements and clover increase on the pedigree swards was substantial (over 70 per cent) under grazing but not under cutting ; on the commercial it was about 50 per cent under cutting and very little

TABLE 7 PERCENTAGE DRY MATTER, PERENNIAL RYEGRASS 'O' & 'C' -1958

Period	Management	Plot	Sown grass	White clover	Other grass	Other weeds	Burn and soil
1	Grazing 'O'	S24Ac	81.5	7.8	10.4	0.3	
		IrAc	68.8	13.0	17.4	0.8	
2		S24Ac	77.4	8.0	3.9	T	10.7
		IrAc	68.0	10.7	12.0	0.2	9.1
3		S24Ac	52.3	19.7	4.3	2.9	20.8
		IrAc	37.5	32.2	15.1	1.1	14.1
4		S24Ac	61.6	12.1	7.4	0.2	18.7
		IrAc	44.0	16.5	23.7	0.2	15.6
1	No Grazing 'C'	S24Ac	78.8	13.7	7.5	T	
		IrAc	68.9	12.6	18.5		
2		S24Ac	58.4	19.6	4.2	1.1	16.7
		IrAc	49.4	30.8	10.2	0.5	9.1
3		S24Ac	45.2	30.8	6.6	3.6	11.8
		IrAc	36.1	42.4	10.2	2.4	8.9
4		S24Ac	68.8	13.5	7.7	0.8	9.2
		IrAc	45.2	18.5	25.4	2.8	8.1
1	Grazing 'O'	S24	96.8		2.8	0.4	
		Ir	85.8		12.7	1.5	
2		S24	80.8		4.0	0.3	14.9
		Ir	59.8		26.0	3.7	10.1
3		S24	74.1		5.9	2.5	17.5
		Ir	51.4		31.5	7.7	9.4
4		S24	61.4		9.2	1.4	28.0
		Ir	46.9		32.0	3.9	17.2
1	No Grazing 'C'	S24	94.9		4.2	0.9	
		Ir	68.2		30.6	1.2	
2		S24	87.3		6.9	1.2	4.6
		Ir	61.7		29.0	2.8	6.5
3		S24	78.5		3.9	2.7	14.9
		Ir	52.7		31.2	0.5	15.6
4		S24	64.8		10.5		24.7
		Ir	42.8		39.0	2.5	15.7

under grazing. Other weeds too increased more on the commercial swards under both managements.

Differences between sown grass under both managements on the pure grass swards were greater under cutting than grazing which shows the greater susceptibility of the commercial to the former treatment.

Leaf-stem ratios are shown in Table 8 after log transformation to overcome variability of the figures.

TABLE 8 LEAF-STEM RATIO - PERENNIAL RYEGRASS - 'O' and 'C' - 1958

LOG (100x) TRANSFORMATION

Period	Management	Treatment				S.E. of means of 3
		S24Ac	IrAc	S24	Ir	
1	Grazing 'O'	2.5	2.6	2.8	2.7	± 0.11
2		1.4	1.3	2.1+++	2.1+++	± 0.10
3		2.5+	2.2	2.6+	2.3	± 0.08
4		2.8	2.9	2.8	2.8	± 0.06
1	No Grazing 'C'	2.3	2.3	2.6	2.3	± 0.18
2		1.7	1.6	1.9+	1.8+	± 0.06
3		3.0	2.6	2.8	2.6	± 0.19
4		3.0+	3.4+	2.9	2.9	± 0.15

\+ 0.05 level significance
+++ 0.001 " "

Under grazing the highly significant difference in period 2 in favour of the nitrogen treatments was due largely to the stage of growth of the swards. These plots which were producing less herbage than the clover plots, were nearly grazed off on each occasion ; there was more feed available on the grass-/clover plots which were incompletely utilised when the grasses

were running to stem and seed. After topping at the end of period 2 the pedigree was superior at the 0.05 level during the summer (period 3).

With no-grazing , however , there was still a slight difference in period 2 at the 0.05 significance level in favour of the nitrogen treatment and in period 4 at 0.05 in favour of the clover treatment. It was observed that the higher leaf-to-stem ratio was associated with a greater growth rate. The trends under both managements are similar for all four periods. Analyses of variance are shown in Appendix 7 (a - d).

(c) "Foggage"

Table 9 shows the average percentage burn collected from each treatment plot for ryegrass under grazing during period 1.

TABLE 9 - MEAN YIELDS BURN - PER CENT - ' 0 ' PERENNIAL RYEGRASS

PERIOD 1 - 1958

S24Ac	IrAc	S24	Ir	S.E. of Means of 3
15.6	16.6	32.9+	24.5+	± 4.07

+ 0.05 Level significance

There was a significant difference at the 0.05 level , percentage burn being greater with the nitrogen treatment for both pedigree and commercial. The varietal differences within the nitrogen and clover treatments are not significant.

Table 10 shows figures for burn under no-grazing conditions for both ryegrass and cocksfoot.

TABLE 10 MEAN YIELDS BURN - PER CENT - 'C' - PERIOD 1 - 1958

Species	Clover	No Clover	Commercial	Pedigree	S.E. of Means of 3
Ryegrass + Cocksfoot	24.3	37.5+	26.9	34.9	± 2.9
Ryegrass + Cocksfoot	30.1 31.8				S.E. of Means of 12 ± 2.2

+ 0.05 level significance

Here again with the nitrogen treatment a significant difference was found at the 0.05 level. No differences existed in this case between the two species , and the difference between pedigree and commercial was not significant , although with and without grazing there was more burn on the pedigree grass. This probably resulted from the previous winter treatment. Appendix 8 (a-c) shows percentage burn per treatment with analysis of variance.

(d) Per cent nitrogen in the herbage

Table 11 (page 61) gives the nitrogen percentage of herbage under both managements for perennial ryegrass. During periods 1 and 2 under grazing there was a significant difference in herbage nitrogen in favour of the nitrogen plots and the same difference in favour of the commercial in period 2 at 0.05 level. Under no-grazing conditions a similar difference occurred in period 1 at 0.05 ; in period 2 the difference was of the same type but not significant. This is presumably due to the higher compensating value of the applied nitrogenous fertiliser for the clover nitrogen. This is borne out by Table 8 , the greater percentage

nitrogen being related also to the greater leafiness of the sward. Appendix 9 (a - g) gives figures for herbage nitrogen per cent and analysis of variance.

TABLE 11 HERBAGE NITROGEN PER CENT - PERENNIAL RYEGRASS - 1958

Period	Management	Plot				S.E. of Mean of 3
		S24Ac	S24	IrAc	Ir	
1	Grazing 'O'	3.25	4.33+	3.26	3.97+	± 0.26
2		1.84	2.56++	2.21	3.05++	± 0.15
3		2.17	2.38	2.57	2.63	
4		2.49	2.31	2.81	2.60	
Total		9.75	11.58	10.85	12.25	
1	No Grazing 'C'	2.61	3.58+	2.83	3.26+	± 0.21
2		1.97	2.72	2.44	2.60	± 0.18
3		2.69	2.72	2.96	2.40	± 0.19
4		2.59	2.31	2.71	2.60	± 0.14
Total		9.86	11.33	10.94	10.86	± 0.55

\+ 0.05 level significance
++ 0.01 " "

(e) Intake studies

Estimations were made in June and August to September as previously described. Table 12 gives the total dry matter and nitrogen content of the herbage on offer , together with the live-weight returns from each treatment on both occasions.

TABLE 12 LIVE-WEIGHT INCREASE , PLOT DRY MATTER AND HERBAGE NITROGEN PER CENT - 1958

TREATMENT	INTAKE STUDIES					
	1 11.6.- 25.6.			2 29.8.- 12.9.		
	L.W.I. (lbs.)	D.M./Plot x 100 lb.	% N Herbage	L.W.I. (lbs.)	D.M./Plot x 100 lb.	% N Herbage
1 : C + N	(1) 24	(4) 2.26	(1) 2.92	(2) 0	(3) 3.47	(2) 2.44
2 : C + Ac	(2) 23	(2) 5.55	(2) 2.14	(1) 3	(2) 3.75	(1) 2.47
3 : P + N	(3) 9	(3) 5.11	(3) 2.01	(4) -22	(1) 3.76	(4) 2.13
4 : P + Ac	(4) 1	(1) 5.79	(4) 1.92	(3) -8	(4) 2.97	(3) 2.17

In both cases the live-weight increase followed the same trends as the figures for percentage of herbage nitrogen . In the case of the clover swards , live-weight increase showed an inverse relationship with the dry matter on offer (in the first study) , and a direct relationship in the second. On the nitrogen swards there was an inverse relationship on both occasions. It is clear that where herbage amounts were vastly different the nitrogen percentage reflects the live-weight performance. Total dry matter intake , digestibility and faecal organic matter output are shown in Table 13 (page 63).

During the first study there was a direct relationship between the amount of herbage consumed and the faecal output , and a nearly direct one during the second : on the clover and nitrogen treatments both were direct . The amount of dry matter consumed was always greater on the clover than on the nitrogen swards , which is probably associated with the clovers rendering the herbage more palatable.

TABLE 13 DRY MATTER INTAKE , DIGESTIBILITY AND FAECAL ORGANIC MATTER PRODUCTION - 1958

TREATMENT	Dry Matter Eaten (lbs.)		Digestibility %		Faecal O.M. Output (lbs.)	
	Intake		Intake		Intake	
	1	2	1	2	1	2
1 : C + N	(4) 3.25	(3) 3.27	(1) 74.1	(4) 73.6	(4) 348	(2) 357
2 : C + Ac	(1) 4.52	(1) 4.45	(2) 73.9	(1) 79.1	(1) 487	(1) 380
3 : P + N	(3) 3.28	(4) 2.81	(3) 73.2	(3) 75.1	(3) 364	(4) 289
4 : P + Ac	(2) 3.45	(2) 3.52	(4) 71.2	(2) 77.0	(2) 410	(3) 334

Except in the commercial nitrogen treatments, the digestibility of the swards on the second trial was higher than on the first ; and again bore a direct relationship to the herbage nitrogen , which was higher on the second occasion : the clover swards were especially leafy then . The slight differences in digestibility (1 to 2 units) between varieties are small and of little account. Intake on the second occasion was slightly less than on the first except on the pedigree clover sward , where it was slightly greater , which was due to leafier material ; the intake on the commercial clover sward was consistently 30 per cent higher than on the pedigree clover , while on the nitrogen swards it was higher on the commercial (by 14 per cent in the second study).

Differences in the growth pattern , and hence the stage of growth at utilization , and clover content render varietal comparisons difficult, and they have in fact complicated the within-clover treatments , especially

since the increased intake on the commercial sward may have been due to greater consumption of both grass and clover . Differences in herbage yield can thus be measured by complete utilisation over a short period. Table 14 shows details of herbage consumption by the difference method compared with estimations from intake studies on the first occasion.

TABLE 14 INTAKE BY THE DIFFERENCE METHOD AND BY FAECAL REGRESSION

TREATMENT	Before Grazing Plot D.M. (x 100 lbs.)	After Grazing Plot D.M. (x 100 lbs.)	Estimated Intake Differences D.M. (x 100lbs.)	Intake by Faecal N (x 100 Lbs.
1 : C + N	2.26	2.65	(4) -0.39	(3) 1.84
2 : C + Ac	5.55	3.32	(1) +2.23	(1) 2.52
3 : P + N	5.11	5.16	(3) -0.05	(3) 1.84
4 : P + Ac	5.79	4.05	(2) +1.74	(2) 1.92

Table 14 shows a remarkable closeness in the intake figures arrived at by both methods of determination for the clover swards because of the small differences in growth taking place between both sampling dates : the nitrogen plots showed marked differences in growth pattern over the period. (Figure 9) . The pattern of increase in both methods is similar. It would thus seem that comparative , and possibly absolute , yield determinations are likely over a fairly long period if growth is very slight. Appendix 10 gives details of faecal output with nitrogen , chromic oxide and ash values.

(f) Silage yields

Table 15 gives mean yields of silage reaped per treatment during the spring and autumn.

TABLE 15 MEAN YIELD SILAGE - (x 10 lb.) PER ACRE -RYEGRASS -1958

CUT IN	TREATMENT				S.E. of Means of 3
	S24Ac	S24	IrAc	Ir	
Silage					
Spring	336.0*	345.0	282.0*	240.0	± 22.1
Autumn	183.0	161.0	159.0	199.0	± 21.0

* 0.05 level significance

Spring yields on the clover swards were greater than those on the corresponding nitrogen plots ; the differences were significant at the 0.05 level and show a similar though smaller trend to those shown in Table 3 on pre-grazed swards within the same period. Other treatments were not significantly different. Appendix 11 (a - d) gives yield figures with analyses of variance.

(g) Discussion

Under cutting the differences between the amount of clover on the commercial and pedigree swards were less than those under grazing , and were from 40 to 25 per cent (Tables 1 and 5). Sown grass appears to have remained constant throughout,with a bigger increase of clover and other species on the commercial suggesting that sown grasses must have suffered a greater reduction on the commercial plots. Both these factors prevented the commercial from being superior in period 3 under no-grazing (Table 5) as it was under grazing (Table 1).

The implication from this is that even in a wet year such as 1958,

very close cropping of such swards leads to the suppression of sown grass and , by modifying the clover percentage , leads to a more closely comparable clover stand on both commercial and pedigree swards. This admit of a fairer comparison between varieties.

Sown grass on pedigree pure grass swards shows a similar increase over the commercial. Unsown species (under cutting mainly grasses , although other weeds appeared too under grazing) were in both cases greater to the same extent on the commercial. As with clover swards the greater differences between varieties under cutting could be due to the greater susceptibility of the commercial to close cutting (Table 7). The better yield of the commercial under cutting in period 4 (Table 5) was due to the large amount of unsown grass on the area which could have been the result of the wet season.

All the evidence suggests greater persistence in the pedigree swards without or with clover . They thus produced more dry matter per acre than the not-so-persistent commercial in spite of the incursion of unsown species. The difference in percentage contribution of sown grass in favour of the pedigree and also the amount of herbage left for recovery could account for the lower spring yields on the commercial plots. On clover plots yields were about the same with a higher clover content especially from June to September. The advantage of such spring pedigree swards in their second harvest year with their higher yield and balanced clover content seem quite obvious . In the later summer the clovery commercial swards tend to give the greatest returns.

The graphs (Figures 8 and 9) show dry matter estimations on consecutive sample dates under grazing and cutting to be very similar. The larger differences during periods 2 and 3 between nitrogen and clover

treatments under cutting as against grazing must be due to faecal returns and the reduction of clover which would help to reduce the difference.

Under grazing , differences in clover contribution and in sown grass as well as the degree of utilisation of the sward render a comparison difficult. Under cutting , where the utilisation is similar , the relative dry matter production was similar,but there were changes in the contribution of the components with more especially a lowering in the clover differences and an increase in sown-grass proportions. It would therefore seem that separate swards of pedigree and commercial clover swards would result in maximum output of dry matter from the former in the spring and from the latter in summer. A similar pattern emerged from the pure grass swards , where , in summer , the differences were reduced. It seems as though differences in management of both varieties should be contemplated to keep the swards at the same stage of growth and clover content , relative to each other , in order to make the comparison more objective.

This would allow the nitrogen and leaf-stem figures to reflect , not so much the clover content and differences in age of herbage , as data for swards at similar stage of growth. Such factors are also important when live-weight figures are considered .

C. Cocksfoot

(a) Yields under grazing - ' 0'

Figure 10 (page 68) shows the amount of herbage on offer at each grazing on both clover and no-clover plots during the year. Yields are divided into three instead of four periods as no grazing of these swards took place during period 2.

FIGURE 10 PLOT DRY MATTER - COCKSFOOT - '0' - 1958

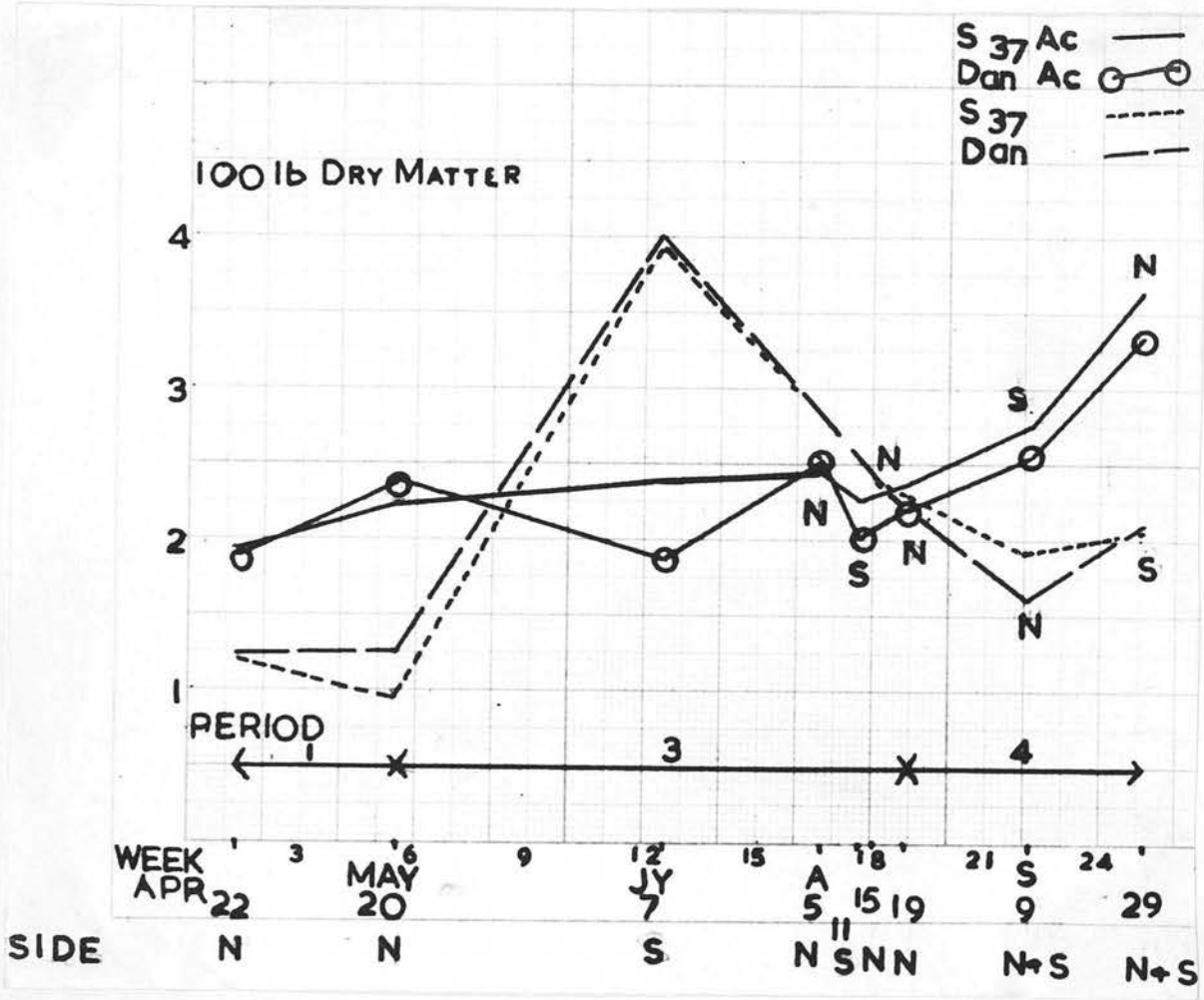


TABLE 16 DRY MATTER - (x 100 lbs) PER ACRE - '0' - 1958

Period	Plot	Cor. D.M./ac.	White Clover	Sown grass	Other grass	Other weeds
1	S37Ac	22	1	20	1	
	DanAc	23	1	20	2	
3	S37Ac	50	3	41	6	
	DanAc	46	5	35	6	
4	S37Ac	34	1	29	4	
	DanAc	32	1	27	4	
Total	S37Ac	106	5	90	11	
	DanAc	101	7	82	12	

(1) Grass-clover

Table 16 (page 68) shows that during period 1 the pedigree outyielded the commercial swards with an overall increase for the year of over 500 pounds or just over 6 per cent dry matter which was not significant (see Table 17). Appendix 12 (a) gives details of yields with analysis of variance.

Yields of other grasses and weeds are the same in both swards , sown grass is 10 per cent higher in the pedigree sward and white clover 40 per cent higher in the commercial.

Table 17 gives mean yields and standard error during each period. Appendix 12 (b - d) gives analysis of variance for each period.

TABLE 17 DRY MATTER YIELD - (x 10 lbs.) MEAN YIELDS AND STANDARD ERROR - '0' - 1958

Period	S37Ac	DanAc	S37	Dan	S.E. of Means of 3
1	2220^{+++}	2290^{+++}	1150	1320	± 138
3	503.0^{++}	459.2			± 3.18
4	341.0	317.0			± 14.3
1,3,4	1070	1005			± 26.0

++ 0.01 level significance
+++ 0.001 " "

It was not considered necessary to analyse the figures for period 1 within clover and nitrogen separately , as the differences were too small to be significant. During period 3 there was a difference of 600 pounds in favour of the pedigree sward significant at 0.01 level ; there was no significant difference in period 4 , the figures showed 200 pounds in

favour of the pedigree .

Table 17 also gives yields during period 1 for a clover - no-clover comparison showing a very high significant difference in favour of the clover swards.

(2) "Pure" grass

Yields of the pure grass swards were higher during periods 1 and 3 from the commercial but lower in period 4 - Table 18 .

TABLE 18 DRY MATTER - (x 100 lbs.) PER ACRE - '0' - 1958

Period	Plot	Cor. D.M./ac.	Sown grass	Other grass	Other weeds
1	S37	12	11	1	
	Dan	13	12	1	
3	S37	34	33	1	
	Dan	34	34		
4	S37	21	20	1	
	Dan	20	19	1	
Total	S37	67	64	3	
	Dan	67	65	2	

The overall yield differences for the year were negligible (Table 19). Under the commercial swards sown grass was higher by less than 2 per cent and just over 50 per cent more other grasses were on the pedigree swards ; other weeds , though 16 per cent higher on the commercial swards , were insignificant in both cases . Total yields are shown in Table 19 (page 71) for periods 3 and 4 and are not significantly different. Appendix 12 (e) gives yields each sample date and analysis of variance for the year.

TABLE 19 DRY MATTER (x 10 lbs.) MEAN YIELDS AND STANDARD ERROR ' O ' - 1958

Period	S37	Dan.	S.E. of Means of 3
3	330.5	340.4	± 7.32
4	213.0	197.0	± 21.6
1,3,4	669	658	± 31.0

In both cases the commercial yielded more in period 1 and was in fact slightly earlier in starting growth in the spring ; the pedigree was superior in period 4 . On the pure grass sward the commercial was equal to the pedigree in period 3, a fact that may have been due to the initially poorer stand of sown grass on the pedigree sward and to its slower rate of growth to July. Appendix 12 (f and g) gives analysis of variance for periods 3 and 4 .

(b) Yields under cages 'C'

Figure 11 gives the yields of herbage reaped under cages every three weeks both for clover and no-clover swards.

(1) Grass-clover

Yields in each period are shown in Table 20 (page 72) . Appendix 13 (a) gives full details for each sample date with analysis of variance for the year.

Only during period 1 was the yield of the pedigree superior ; for the whole year the pedigree gave 300 pounds more dry matter than the commercial which was not significant (Table 21). There were 12 per cent more sown grass and 72 per cent more other species on the pedigree swards ,

TABLE 20 DRY MATTER - (x 100 lbs.) PER ACRE - 'C' - 1958

Period	Plot	Cor. D.M./Ac	White clover	Sown grass	Other grass	Other weeds
1	S37Ac	45	2	34	8	1
	DanAc	38	6	27	5	
2	S37Ac	19	2	14	2	1
	DanAc	20	4	14	2	
3	S37Ac	55	10	39	4	2
	DanAc	55	14	32	8	1
4	S37Ac	31	4	24	3	
	DanAc	34	3	25	6	
	S37Ac	150	18	111	17	4
Total	DanAc	147	27	98	21	1
1	S37	53		50	2	1
	Dan	35		33	2	
2	S37	22		21	1	
	Dan	17		14	2	1
3	S37	56		53	2	1
	Dan	59		56	2	1
4	S37	28		24	4	
	Dan	22		20	2	
	S37	159		148	9	2
Total	Dan	133		123	8	2

the latter mainly docks (Rumex spp.) and ribgrass ; the commercial contained 44 per cent more clover and 14 per cent more other grasses than the pedigree. Mean yields are given in Table 21 in each period of the year with significance levels.

FIGURE 11 PLOT DRY MATTER - COCKSFOOT - 'C' - 1958

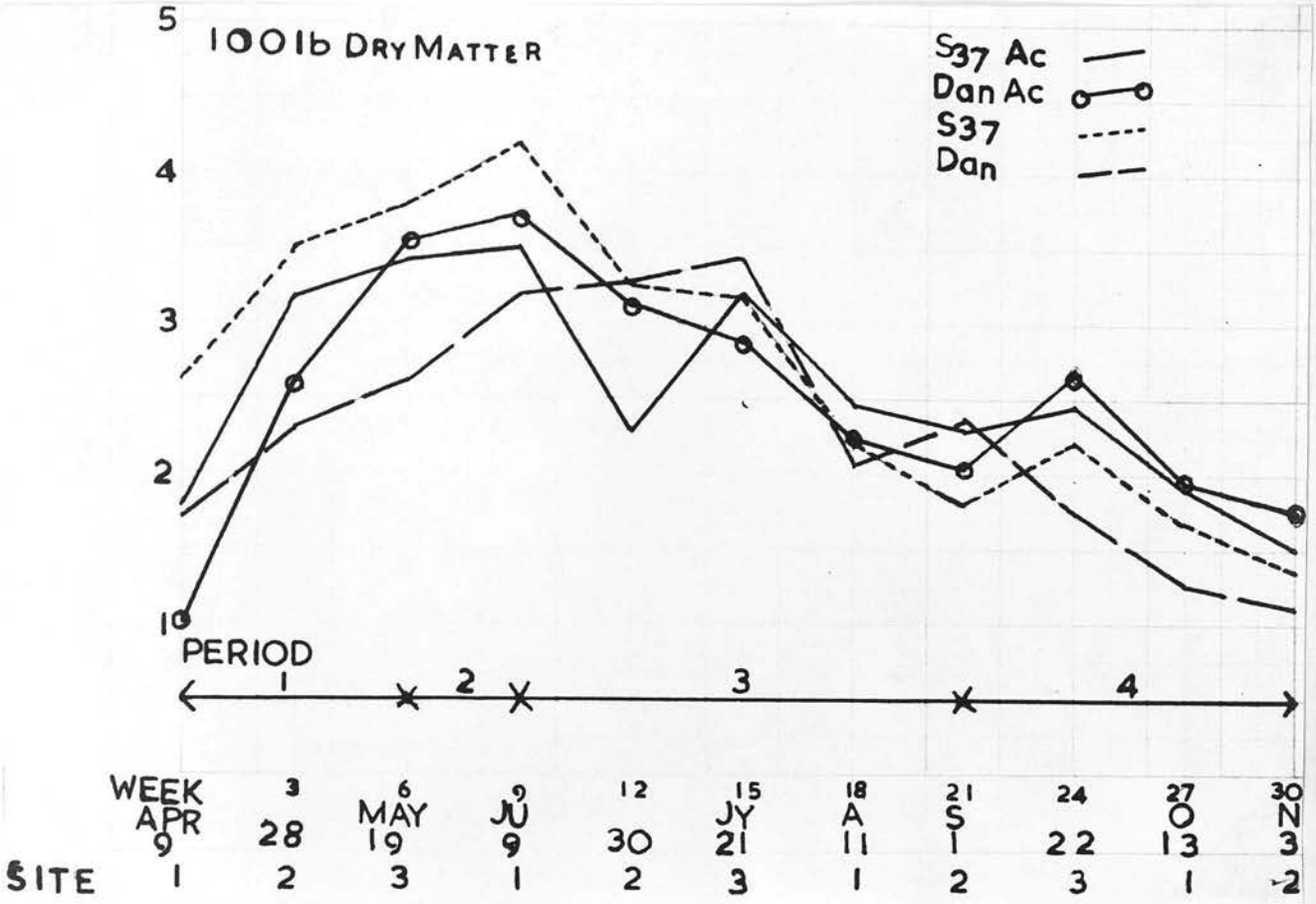


TABLE 21 DRY MATTER - (x 10 lbs.) - MEAN YIELDS AND STANDARD ERROR - 'C' - 1958

Period	S37Ac	DanAc	S37	Dan	S.E. of Means of 3
1	446.0	381.0	528.0	354.0	± 64.8
2	186.0	198.0	224.0	169.0	± 22.1
3	545.0	547.0	558.0	593.0	± 46.1
4	313.0++	338.0++	279.0	219.0	± 18.2
1-4	1520	1590	1460	1340	± 103

++ 0.01 level significance

There was a very significant difference between clover and nitrogen treatments in period 4 at the 0.01 level. None of the differences within clover and no-clover treatments throughout are due to anything but chance. Analysis of variance each period is given in Appendix 13 (b - e).

(2) "Pure" Grass

Yields for the year are shown in Table 20 (page 72) and are higher on the pedigree swards on all but the third period , the total increase for the year was 2600 pounds in favour of the pedigree which was not significant. There was no significant difference within nitrogen treatments over the four periods. Sown grass was nearly 20 per cent greater on the pedigree swards while other grasses were slightly higher on the pedigree ; other weeds were 44 per cent higher than on the commercial plots. As compared with the corresponding clover swards sown grass increased by 26 and 34 per cent on the commercial and pedigree plots respectively. Yields at each sample date are shown in Appendix 13 (f).

Under no-grazing the pedigree swards were superior during period 1 but not under grazing ; this may be due to choice of site. During period 3 the commercial was better on both. In periods 2 and 4 the positions were reversed on grass and clover swards ; on the pure grass sward the greater pedigree yield in period 4 is similar to that of both swards under grazing. The sown-grass yield on the pedigree clover sward in period 4 , which was below that of the commercial under cutting , accounted for the difference. A similar reduction was noted under grazing (Table 22) .

Yields under grazing (Figure 10) compared with yields under no-grazing (Figure 11) show a greater similarity in yield pattern for the pure grass swards from the end of June onwards. The lower initial difference was due to the much lower yielding sites of the commercial plots on two of the

replicates.

TABLE 22 PERCENTAGE DRY MATTER -COCKSFOOT- 'O' & 'C' -1958

Period	Management	Plot	Sown grass	White clover	Other grass	Other weeds	Burn & soil
1	Grazing 'O'	S37Ac	91.3	3.6	5.1	T	
		DanAc	86.2	6.4	6.8	0.4	
2		S37Ac					
		DanAc					
3		S37Ac	64.1	4.9	9.7	0.3	21.0
		DanAc	60.7	8.5	10.5	0.1	20.2
4		S37Ac	73.8	3.0	10.3	0.1	12.8
		DanAc	77.3	2.4	10.2		10.1
1	No Grazing 'C'	S37Ac	76.7	5.4	16.7	1.2	
		DanAc	72.0	14.3	12.9	0.8	
2		S37Ac	64.0	9.3	11.9	3.4	11.4
		DanAc	60.0	17.6	8.8	1.3	12.3
3		S37Ac	64.0	17.1	6.8	2.8	9.3
		DanAc	47.9	22.0	11.6	1.8	16.7
4		S37Ac	69.6	10.9	10.0	1.0	8.5
		DanAc	68.1	7.0	16.3	0.4	8.2
1	Grazing 'O'	S37	97.2		2.8		
		Dan	96.3		3.7		
2		S37					
		Dan					
3		S37	86.4		3.2	0.3	10.1
		Dan	94.9		0.9	0.5	3.7
4		S37	71.7		3.5	0.1	24.7
		Dan	68.4		4.1		27.5
1	No Grazing 'C'	S37	94.6		3.2	2.2	
		Dan	94.9		7.1	T	
2		S37	85.0		4.2	0.2	10.6
		Dan	73.5		10.3	3.1	13.1
3		S37	82.6		3.4	1.6	12.4
		Dan	83.2		3.9	1.9	11.0
4		S37	75.0		13.0	1.2	10.8
		Dan	73.3		5.5		21.2

On the clover swards the pattern is similar at the beginning , the commercial growing faster to late May. The very low yield on one replicate on June 30 , accounts for the dip on the pedigree clover plot in Figure 11. The superiority of the commercial,under cutting,in period 4 may have been due to greater growth and more competition from the clover on the pedigree plots (Table 22) where the percentage of clover increased over the commercial plots for the first time under both managements. The percentage of herbage nitrogen was also greater than that of the commercial swards.

Results of leaf-to-stem ratio tests carried out during the year are shown in Table 23 for each period both under grazing and no-grazing conditions. Analysis of variance is shown in Appendix 14 (a- d) .

TABLE 23 LEAF-STEM RATIO - COCKSFOOT - 1958

LOG (100_x) TRANSFORMATION

Period	Management	Treatment				S.E. of Means of 3
		S37Ac	DanAc	S37	Dan	
1	Grazing	2.8+++	2.3	3.0+++	2.4	± 0.09
2						
3		3.2	3.3+	2.9	3.1+	± 0.10
4		2.6	2.6	2.5	2.6	± 0.05
1	No Grazing	2.5+	2.1	2.9+	2.4	± 0.12
2		2.5	2.2	2.7	2.5	± 0.15
3		3.3	3.2	2.9	3.1	± 0.11
4		2.6	2.7+	2.6	2.8+	± 0.05

\+ 0.05 level significance
+++ 0.001 " "

Under grazing conditions there was a significant difference at the 0.001 level in favour of the pedigree in period 1 where growth was later hence more leafy and quicker ; and in period 3 at the 0.05 level in favour of the commercial which was growing faster at that time. Under no-grazing the difference is at the 0.05 level in period 1 in favour of the pedigree and in period 4 in favour of the commercial ; a fact that helped to substantiate the under grazing treatments. It would appear that the higher values are associated with the higher rate of growth which may determine the stage of growth of comparable varieties at a particular time. This result is similar to the perennial ryegrass picture where the greater burn build-up seems to indicate a lower rate of growth hence lower leaf to stem ratio.

(c) "Foggage"

Table 24 gives the average percentage burn per treatment plot on cocksfoot swards under grazing during period 1 with significance levels. Appendix 15 gives per cent burn and analysis of variance.

TABLE 24 MEAN YIELDS BURN - PER CENT - '0' - COCKSFOOT -1958

S37Ac	DanAc	S37	Dan	S.E. of Means of 3
32.3^{++}	17.2	64.3^{++}_{+++}	53.7_{+++}	± 2.21

++ 0.01 level significance
+++ 0.001 " "

The greater amount of burn on the nitrogen as against clover treatment was highly significant at the 0.001 level and with the pedigree at 0.01 level. Greater amount of burn material could be due to the less

palatable material left ungrazed by the sheep the previous year and to a higher total production.

(d) Per cent nitrogen in the herbage

Per cent nitrogen per treatment is shown in Table 25 for both managements. Appendix 16 shows analysis of variance.

TABLE 25 HERBAGE NITROGEN PER CENT - COCKSFOOT - 1958

Period	Management	Plot				S.E. of Means of 3
		S37Ac	S37	DanAc	Dan	
1	Grazing 'O'	3.70	3.54	3.42	3.37	± 0.38
2						
3		2.25	3.05	2.43	3.04	
4		2.38	2.46	2.62	2.58	
Total	No Grazing	8.33	9.05	8.47	8.99	
1	No Grazing 'C'	2.79	3.85^{+++}	2.70	3.95^{+++}	± 0.13
2		1.87	2.89^{+++}	2.14	3.05^{+++}	± 0.13
3		2.40	2.57	2.56	2.91	± 0.11
4		2.79	2.61	2.65	2.91	± 0.15
Total		9.85	11.92^{++}	10.05	12.82^{++}	± 0.46

++ 0.01 Level significance
+++ 0.001 " "

Under grazing conditions values for period 1 show no significant differences . For the other periods a clover/no-clover comparison was not logical for reasons already mentioned. Under no-grazing the nitrogen treatment showed a significantly higher value for the year at the 0.01 level . During periods 1 and 2 the nitrogen treatments also showed a significant difference at the 0.001 level over the clover treatments.

Up to early June , that is after the late May fertiliser application, the Nitro-Chalk applied seemed to have a higher nitrogen value than the corresponding clover-nitrogen output : after this date there was adequate compensation of clover-nitrogen in the later fertiliser programme. It was also observed that on the clover swards the commercial was slightly superior in periods 2 and 3 because of its higher clover content. These swards contained 1/5 the amount of clover of the corresponding perennial ryegrass swards.

(e) Silage and hay yields

Silage yields in spring and autumn (Table 26) show no significant differences in total dry matter production ; but the hay yields (Table 26) reaped in July were significantly different at the 0.01 level in favour of the nitrogen treatment a difference similar to that shown in Figure 11. Appendix 17 (a-c) gives analysis of variance.

TABLE 26 MEAN YIELDS SILAGE AND HAY- (x 10 lbs.) PER ACRE-

COCKSFOOT - 1958

Cut In	Treatment				S.E. of Means of 3
	S37Ac	S37	DanAc	Dan	
Silage					
Spring	296.0	357.0	364.0	355.0	± 32.0
Autumn		177.7		163.1	± 9.02
Hay					
Summer	192.0	308.0++	192.0	320.0++	± 23.4

++ 0.01 level significance

(f) Discussion of results

Under grazing and under no-grazing the amount of sown species was approximately 10 per cent greater on the pedigree than on the commercial swards ; in the commercial/clover swards the increase too was similar under both managements (around 40 per cent). There was a tendency for other grasses and other species to develop more in the pedigree pure grass swards presumably as a result of the finer leaves which gave less shade than the Danish commercial.

During period 1 the yields of the commercial under grazing were slightly greater than those of the pedigree on both swards ; under no-grazing the pedigree yields were greater . Under both managements the pedigree was superior during period 4 as it was during period 3. Under grazing the earliness of the commercial and the greater autumn growth of the pedigree was confirmed. The difference under cutting may be due to choice of site and the greater susceptibility of the commercial to intense cutting. The greater percentage of burn on the pedigree plots during period 1 reflected its greater autumn production in the previous year.

Under both managements the percentage of sown grass increased more on the pure grass as compared with the clover plots , the increase being greater on the pedigree swards. A similar pattern to that shown in the ryegrass plots emerged with regard to the supplemental value of clover nitrogen. Under no-grazing conditions on cocksfoot swards the fertiliser nitrogen was too great in periods 1 and 2 and was about equal to the clover nitrogen in periods 3 and 4. The higher nitrogen values on the perennial ryegrass-clover plots must be due to the greater amount of clover in them than was in the cocksfoot-clover plots. These differences were not found under grazing where , up to period 3 , the higher corresponding

TABLE 27 LIVE- WEIGHT INCREASE , DRY MATTER/ac. AND PER CENT NITROGEN - 1958

TREATMENT	TREATMENT TOTALS 1958			PERIODS											
				1 16.4. - 27.5.			2 11.6. - 25.6.			3 25.6. - 29.9.			4 30.9. - 27.11		
	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N
1: C+N	(3) 258.21	(4) 45	(2) 12.07	(2) 126.22	(4) 8	(3) 3.70	(1) 25.33	(4) 5	(1) 3.08	(4) 85.33	(2) 1.8	(1) 2.72	(3) 21.33	(4) 14	(3) 2.57
2: C+Ac	(1) 334.66	(2) 54	(1) 12.57	(1) 143.11	(2) 11	(1) 5.36	(1) 25.33	(2) 9	(3) 2.18	(1) 141.33	(3) 17	(3) 2.29	(2) 24.89	(2) 17	(2) 2.74
3: P+N	(4) 250.88	(3) 53	(3) 11.47	(4) 116.0	(3) 10	(2) 4.14	(2) 16.0	(3) 9	(2) 2.46	(3) 104.44	(1) 19	(2) 2.56	(4) 14.44	(3) 15	(4) 2.31
4: P+Ac	(2) 273.34	(1) 57	(4) 10.35	(3) 117.78	(1) 12	(4) 3.47	(3) 2.67	(1) 11	(4) 1.84	(2) 124.00	(4) 16	(4) 2.21	(1) 28.84	(1) 18	(1) 2.83
TOTAL	1117.09	209		503.11	42		69.33	34		455.10	70		89.55	64	

values on the clover swards may be associated with the nullifying effect of animal excreta and the significantly higher hay yields from the nitrogen plots (Table 26). The nitrogen plot values are also appreciably higher than the clover ones during period 3.

It is also very obvious that the small amount of clover in the plots must have accounted for the very significant nitrogen differences in periods 1 and 2 under no-grazing conditions.

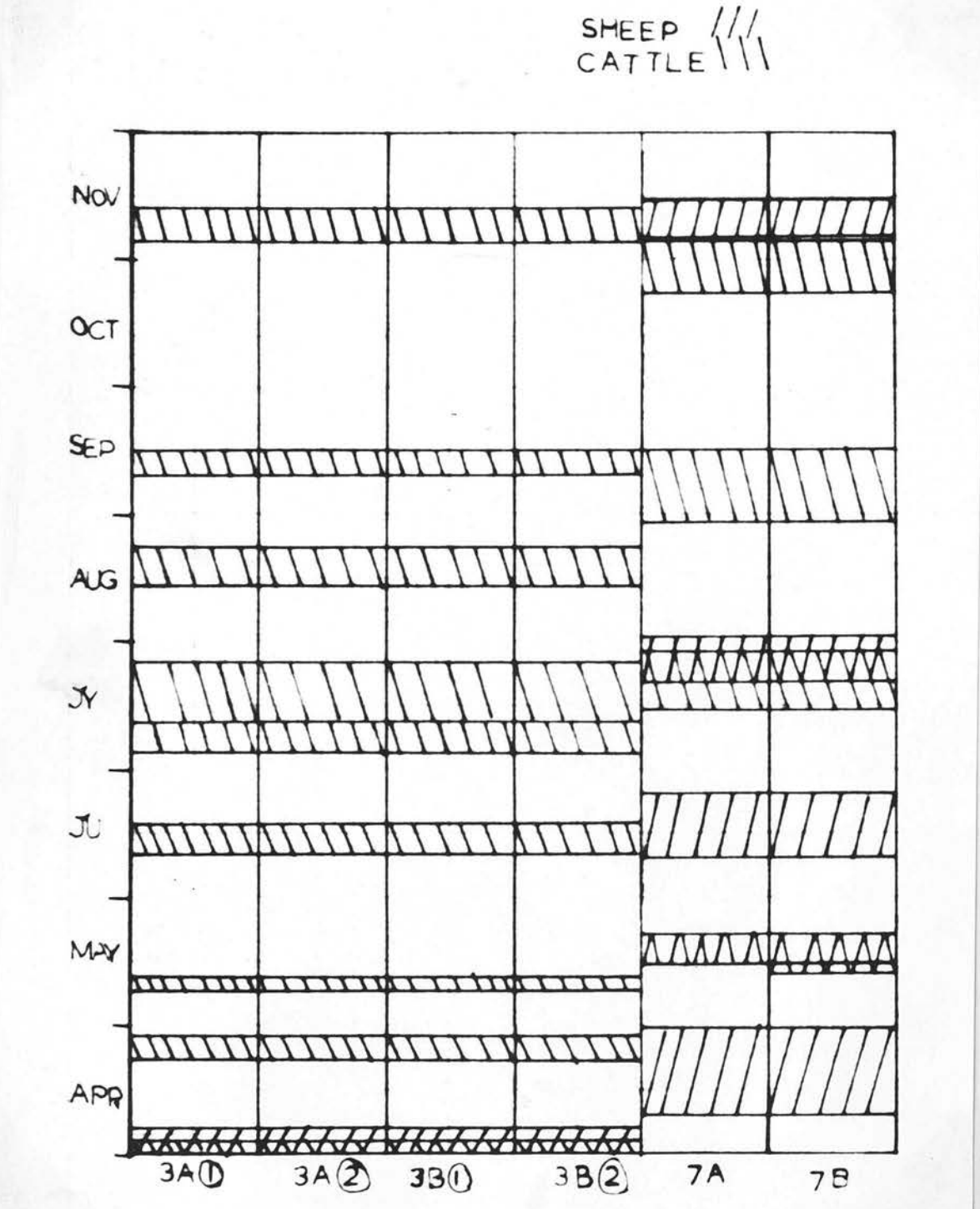
D. Live-weight Data

Table 27 (page 81) shows the live-weight increase per acre with dry matter production per treatment each period also herbage nitrogen per cent.

Apart from period 2 , when only ryegrass was grazed , herbage weights during periods 1 , 3 and 4 reflect average weight for both ryegrass and cocksfoot swards. Although the total live-weight production is directly related to the herbage yield on clover and no-clover swards , the greater animal output from the clover swards being associated with the greater dry matter production from these swards , within these two treatments the reverse is true. In the one it is bound up with the greater clover content on the commercial and the other with the higher quality herbage also on the commercial pure grass swards on all periods but the first .

During the first two periods greater live-weight returns were obtained from the commercial than from the pedigree swards. The very low returns during period 2 on the pedigree clover sward is assumed to be due to the upset of the animals during the intake study and , to some extent , to the very low herbage quality. During periods 3 and 4 the clover swards gave better weight gains ; the latter period showed a direct relationship between per cent nitrogen and animal returns and a strong one to dry matter production. The results show that herbage weights alone cannot be used to predict animal live-weight returns , nor can nitrogen content alone.

FIGURE 12 HERBAGE UTILISATION -1958



111. EXPERIMENT 11 - CHAPEL FIELD 1 and 11 - H15 - 1958

As in experiment 1 the definition of periods during the year has been governed largely by seasonal variation in herbage quality , which has itself influenced the grazing management and fertiliser application. The division into periods is given below :-

Period	1	April 4	to	May 12	Spring and early seed stage
"	2	May 13	"	June 6	Full seed stage
"	3	June 7	"	August 27	Summer growth
"	4	August 28	"	November 3	Autumn growth

Only plot 7 was grazed over the four periods , plot 3 over periods 3 and 4 only. Neither autumn undersown nor spring sown areas in plots 3A and 3B were the same and this rendered direct dry matter comparison impossible without adjustments. All sub-plots A and B were grazed at the same time.

The difference in herbage quality between spring and autumn sowing also introduced the element of choice. In plot 7 there is a slight difference of 0.1 acre in favour of sub-plot A . Figure 12 (page 83) shows when plots were utilised and the type of stock used.

The first two grazings on plots 3A and 3B during April 1 to 6 and April 21 to 25 were intended to utilise the rye. In the first instance sheep and cattle grazed the area , the latter for two days only : cattle alone were used on the second occasion. No before-grazing sampling was done as the autumn undersown sward was not yet established , but sites for sampling under a no-grazing regime were caged during grazing. The spring areas on sub-plots 3A and 3B , sown on April 14 , were grazed between May 8 and 11 by cattle to establish the sward ; and again no pre-grazing

FIGURE 13 DRY MATTER (x 100 lbs.) PER ACRE - '0' - 1958

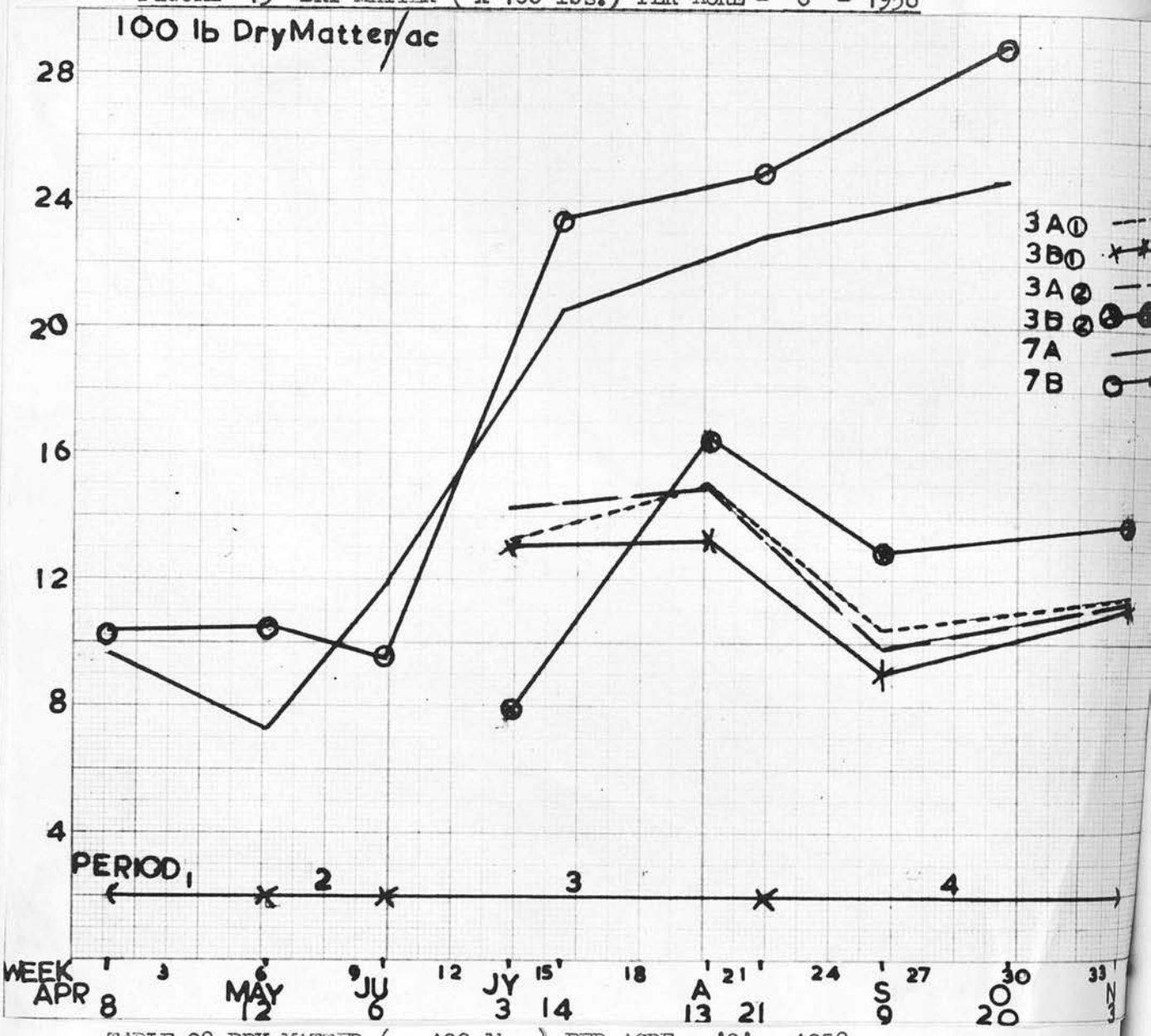


TABLE 28 DRY MATTER (x 100 lbs.) PER ACRE - '0' - 1958

Period	Sown	Plot	Cor. D.M.	Sown grass	Other grass	Other weeds	Rye
3	Autumn	3A1	28	27	1		
		3B1	27	22	1	4	
4		3 A 1	22	20	2		
		3 B1	20	17	3		
		3A1	50	47	3		
Total		3B1	47	39	4	4	
3	Spring	3A2	29	19	7	3	
		3B2	24	12	2	8	2
4		3A2	21	19	2		
		3B2	27	24	1	2	
		3A2	50	38	9	3	
TOTAL		3B2	51	36	3	10	2

sampling was done but areas were protected during grazing for sampling as before. On all other occasions yield of herbage was estimated before grazing on both plots 3 and 7. Estimated yields of dry matter on offer on all sub-plots over the year are shown in Figure 13 (page 85).

It has already been pointed out that lack of replication precludes conclusions being drawn : the information sought here is rather further evidence for this variety study. The initial differences in yield between autumn and spring of the commercial variety must be attributed largely to the longer growing season of the former and , to some extent , to the slow initial ' take ' of the spring sowing . With the pedigree the spring sowing was better established than the autumn and it also showed slightly higher initial production.

A. Italian Ryegrass - Plot 3

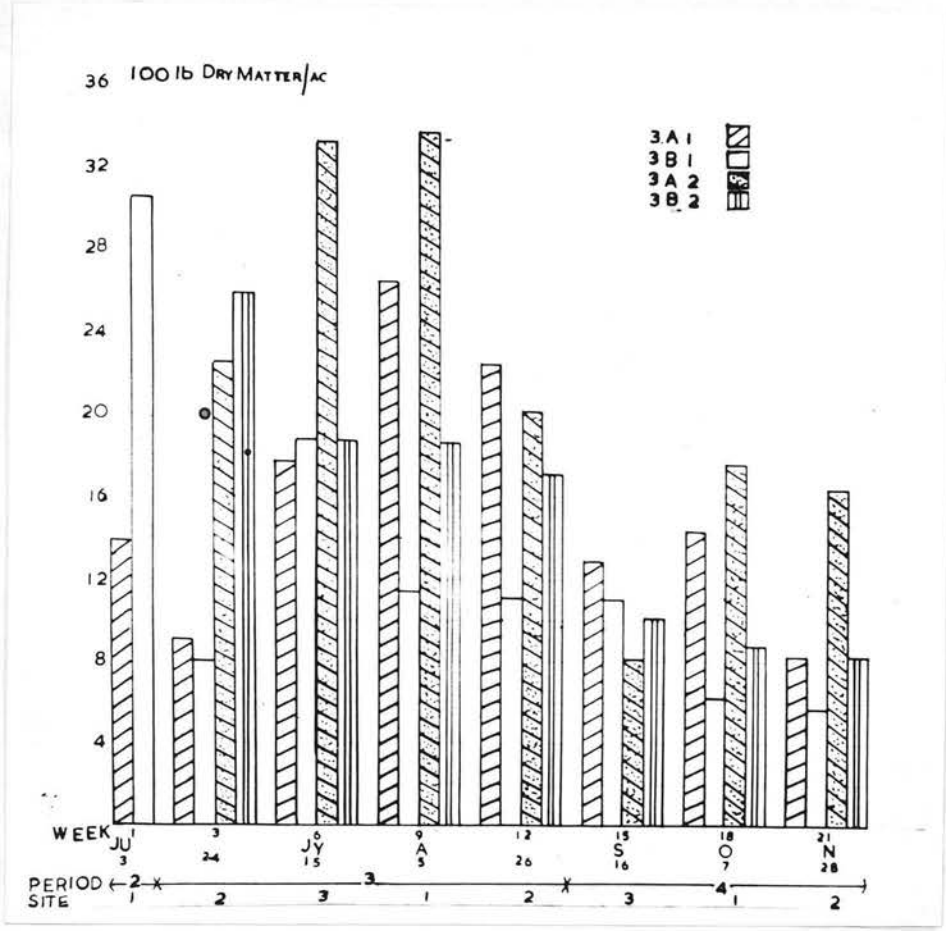
(a) Herbage Yields

(1) Under Grazing - '0'

Table 28 (page 85) gives the total dry matter production in 100 pounds per acre from spring and autumn sown grass. Appendix 18 (a) gives yields each sample date.

On the autumn undersown swards the pedigree grass gave slightly better yields over both periods the total being over 340 pounds or nearly 8 per cent. For the spring sowings the pedigree was superior in period 3 , the commercial in period 4 , the overall totals being practically the same (in fact the commercial produced 60 pounds more). There was no difference in dry matter output from either spring or autumn sown pedigree swards , but the spring sown commercial showed a slight increase of more than 8 per cent in dry matter over the autumn sowing. The differences are not large enough to be significant.

FIGURE 14 - DRY MATTER -(x 100 lbs.) PER ACRE - 'C' -1958.



There were more weeds in both sowings of the commercial ; the increase in the spring was due to the better growing conditions . Although both the amount per acre and the percentage of sown grass were higher on the autumn than on the spring sowing the former herbage was more stemmy (See Table 29).

TABLE 29 PERCENTAGE DRY MATTER - '0' - 1958

Period	Plot	Leaf	Stem	Sown grass	Other grass	Other weeds	Rye	Burn and soil
3	3A1	29.8	65.7	95.5	22.8			1.7
	3B1	20.6	61.1	81.7	3.2	14.3		0.8
	3A2	60.5	5.9	66.4	22.4	10.7		0.5
	3B2	39.7	10.1	49.8	10.4	33.3	6.2	0.3
4	3A1	45.3	20.0	65.3	8.0	T		26.7
	3B1	33.7	28.6	62.3	10.2	2.0		25.5
	3A2	57.8	14.5	72.3	8.4			19.3
	3B2	62.9	16.5	79.4	3.2	6.2		11.2

(2) Under Cages - 'C'

Figure 14 (page 87) shows yields from successive samples over the period.

TABLE 30 DRY MATTER -(x 100 lbs.) PER ACRE - 'C' - 1958

Period	Sown	Plot	Cor. D.M.	Sown grass	Other grass	Other weeds	Rye
2	Autumn	3A1	13	6	1		6
		3B1	31	18	1	4	8
3		3A1	76	70	5	1	
		3B1	49	45	2	2	
4		3A1	36	35	1		
		3B1	21	12	7	2	
Total		3A1	125	111	7	1	6
		3B1	101	75	10	8	8
3	Spring	3A2	109	101	8		
		3B2	80	47	5	8	20
4		3A2	42	42			
		3B2	27	22	3	2	
Total		3A2	151	143	8		
		3B2	107	69	8	10	20

On the autumn sown swards the first cut shows an appreciable yield difference in favour of the commercial. Even when rye yields are taken out it represents nearly 2300 pounds dry matter per acre. The difference for the year was 2400 pounds or 24 per cent in favour of the pedigree (See Table 30 , page 88). Yields on each sample date are shown in Appendix 18 - (b).

On the spring sowing the first-cut yield of the commercial was greater ; and the total annual yield difference was 4400 pounds or 41 per cent more dry matter in favour of the pedigree. The increase in yield of spring to autumn sown pedigree swards was about 20 per cent ; on the commercial it was about 6 per cent. Both the total amount and the percentage of sown grass were greater on the commercial in period 2 but the position was reversed in periods 3 and 4. Table 31 shows that unsown species were also always greater under the commercial (not including rye).

TABLE 31 PERCENTAGE DRY MATTER -'C' - 1958

Period	Plot	Leaf	Stem	Sown grass	Other grass	Other weeds	Rye	Burn & soil
2	3A1	15.4	30.3	45.7	8.2	0.7	45.4	
	3B1	14.7	43.1	57.8	3.5	13.2	25.5	
3	3A1	42.5	48.7	91.2	6.2	0.9		1.7
	3B1	26.5	53.4	79.9	3.9	4.2		12.0
	3A2	67.8	22.2	90.0	7.4			2.6
	3B2	45.1	12.7	57.8	6.3	10.5	24.1	1.3
4	3A1	56.3	25.0	81.3	2.0	0.8		15.9
	3B1	29.9	20.9	50.8	26.9	7.4		14.9
	3A2	60.0	31.0	91.0	1.0			8.0
	3B2	59.7	4.2	63.9	9.7	5.6		20.8

By the end of the year the spring sown swards were better established than those sown in autumn ; the pedigree being superior to the commercial.

Graphs for the spring sown and autumn undersown (Figures 13 and 14) are very similar under grazing and under cages ; the only difference was the low commercial first sample yield (June 3) on the spring sown sward , which could have resulted from the grazing that took place between May 8 and 11 and removed all the yield difference reflected in the corresponding first commercial caged cut on June 24. The persistence of rye under cages in the commercial may have been due to lack of competition.

(b) Percentage nitrogen in the herbage

The nitrogen percentage content of the herbage dry matter from all periods are shown for each period in Table 32 , both under grazing and cages.

TABLE 32 PERCENTAGE NITROGEN - HERBAGE DRY MATTER-1958

Period	Treatment	Plot			
		3A1	3B1	3A2	3B2
3	Grazing '0'	2.66	2.44	3.51	3.50
4		2.56	2.49	2.88	2.71
2	Cages 'C'	1.76	1.54		
3		2.63	1.79	3.23	2.26
4		2.85	2.58	2.95	2.82

At all times spring sowing was superior to autumn sowing ; the pedigree grass was also better than the commercial under grazing and cages. Under the latter the difference in quality between autumn and spring sowing was 12 and 17 per cent for pedigree and commercial respectively ; under grazing the difference was 25 per cent for both. The higher values under

' C ' than under '0' in period 4 are due to longer rest of the latter, which meant that the herbage under grazing was older.

(c) Soil data

Details of soil carbon, and nitrogen values for samples taken during the year are shown in Table 33. The carbon values show a greater increase on both sowings under the pedigree swards, while the nitrogen values were higher under the pedigree autumn and the commercial spring sowing.

TABLE 33 PERCENTAGE SOIL CARBON AND NITROGEN -1958

Plot	% Carbon				% Nitrogen			
			Increase				Increase	
	3.3.58	Nov. '58	Amt.	%	Mar. '58	Nov. '58	Amt.	%
3A1	1.54	1.67	0.13	8.4	0.170	0.22	0.05	29.14
3B1	1.97	2.02	0.05	2.5	0.235	0.26	0.025	10.6
3A2	1.49	1.73	0.24	16.1	0.183	0.20	0.017	9.3
3B2	1.95	2.10	0.15	7.7	0.222	0.26	0.038	17.1

(d) Live-weight data

Over the grazing period live-weight returns from cattle were as in Table 34 below.

TABLE 34 PLOT LIVE-WEIGHT INCREASE AND ANIMAL STARCH EQUIVALENT IN POUNDS - 1958

Plot	Calves	Cattle	Live-weight Total S.E.
3A	79	229	2091.1
3B	142	334	2458.3

Only on one occasion was there a loss in weight , on plot 3A with cattle. Both live-weight returns and animal starch equivalent values from the commercial were higher.

(e) Discussion

Under grazing the pedigree variety gave slightly increased dry matter yield over the commercial as compared with the autumn undersown treatment , but yields on the spring sowing were the same. Under cages the pedigree was superior under both sowing dates ; the difference was greater on the spring sowing. The quality of herbage , measured as per cent nitrogen , was higher on the spring sowing and on the pedigree. The percentage sown species was also greater on the spring sowing during period 4 , the swards showing more vigorous growth than the autumn sowing which was slower in covering over.

Quicker establishment and a better quality herbage seems to be the advantage in spring sowing , even when there appears none in total dry matter production. The earliness of the commercial however , is not exploited by spring sowing , which accounts for the greater difference between pedigree and commercial (Table 30 , page 88) under cages.

Table 35 gives the herbage starch equivalent values calculated by Watson and Horton's formula ; and it shows a total value in favour of the pedigree although , on the spring sowing , the commercial is superior to it by nearly 69,000 pounds.

TABLE 35 HERBAGE STARCH EQUIVALENT - (x 100 lbs.) - 1958

Period	Starch Equivalent Values					
	3A1	3B1	3A2	3B2	3A	3B
3	1605	1134	1539	1620	3143	2754
4	1237	873	1075	1681	2312	2554
Total	2842	2007	2614	3301	5475	5308

This reflects a similar picture in the actual dry matter returns from the plots in Table 36.

TABLE 36 PLOT DRY MATTER YIELD - (x 100 lbs.) - 1958

Period	3A1	3B1	3A2	3B2
3	27	19	25	26
4	21	15	18	28
Total	48	34	43	54

The live-weight returns (Table 34 , page 91) were greater from the commercial sward ; which could have been due to animal variability , fill , or the larger portion of spring sown commercial. It was observed throughout that the autumn sowing was little grazed , especially the commercial. When the spring sowing had been grazed bare the animals lay around idling. It is felt that this rather influenced the live-weight return in favour of the commercial especially as over the season on all mixtures greater live-weight gains were made by cattle on the pedigree swards. Soil nitrogen and carbon figures given also show increases which are very variable .

B. Italian Ryegrass Plot 7 - 2nd year - 1958

(a) Herbage Yields

(1) Under grazing '0'

The amount of dry matter on offer during the year has been shown graphically in Figure 13 (page 85) and in Table 37 on page 94. Yields at each sample date are shown in Appendix 19 (a).

TABLE 37 DRY MATTER YIELD - (x 100 lbs.) PER ACRE - '0' -1958

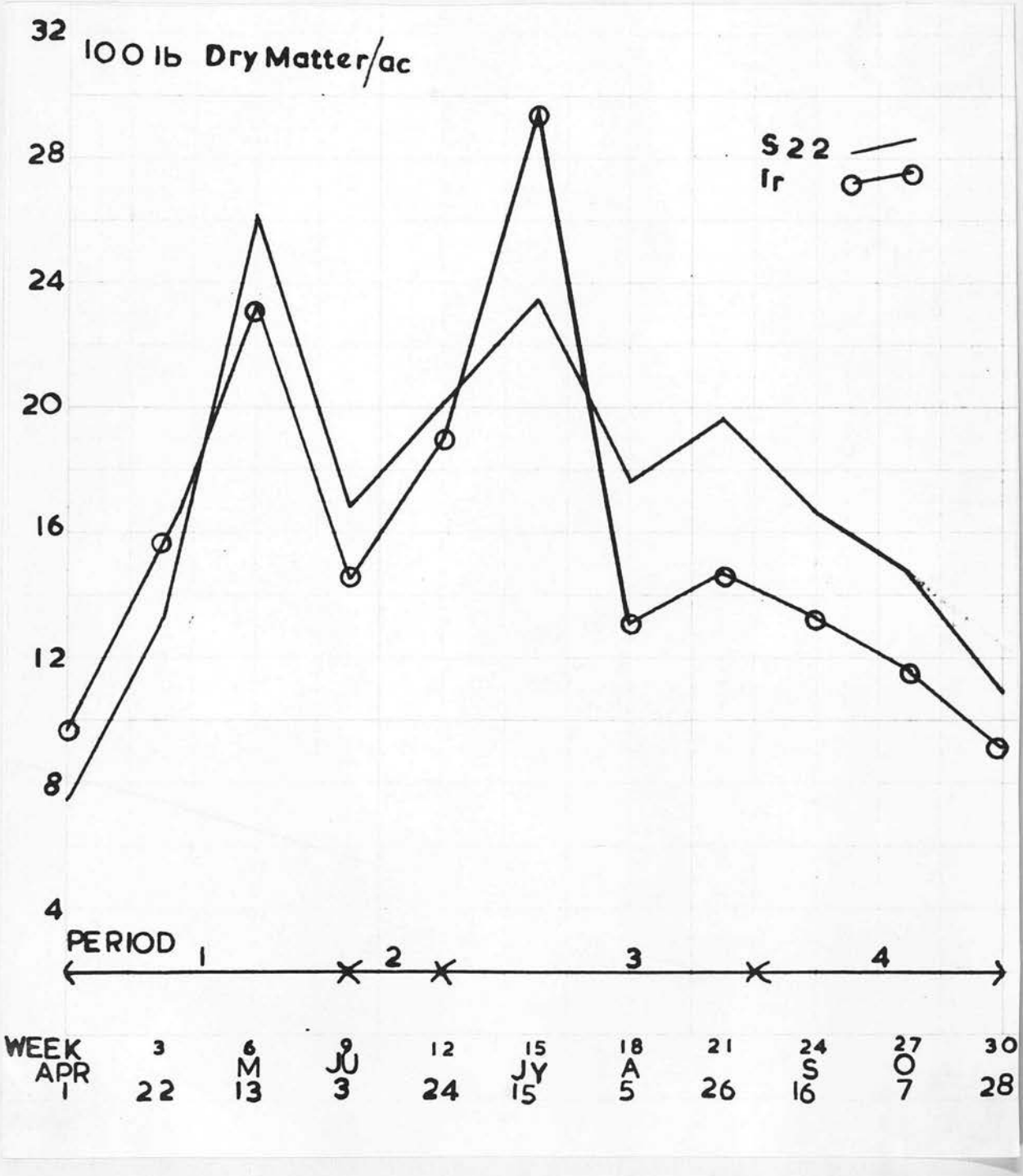
Period	Sown	Plot	Cor. D.M.	Sown grass	Other grass	Other weeds
1	Spring '57	7A	17	17		
		7B	21	21		
2		7A	12	11	1	
		7B	10	9	1	
3		7A	44	39	5	
		7B	48	42	6	
4		7A	25	15	9	1
		7B	29	15	14	
Total		7A	98	82	15	1
		7B	108	87	21	

The total dry matter yield and the amount of sown grass on the pedigree plots were lower in periods 1 and 3 with an overall total difference of 1000 pounds in favour of the commercial. There was no difference in the percentage contribution of sown grass in both swards (Table 38) but there was over 25 per cent more other grass in the commercial than the pedigree sward by the end of the season.

TABLE 38 PERCENTAGE DRY MATTER - '0' -1958

Period	Plot	Leaf	Stem	Sown grass	Other grass	Other weeds	Burn & soil
1	7A	94.4	2.4	96.8	2.4	0.8	
	7B	95.2	2.0	97.2	1.2	1.6	
2	7A	62.1	30.4	92.5	7.5		
	7B	62.1	32.3	94.4	4.8	0.8	
3	7A	40.4	46.0	86.4	12.2		1.4
	7B	53.9	31.5	85.4	12.5	1.0	1.1
4	7A	38.9	11.9	50.8	28.0	3.0	18.2
	7B	33.0	15.1	48.1	44.3		7.6

FIGURE 15 DRY MATTER - (x 100 lbs.) PER ACRE -'C' -1958



Differences in leaf-stem ratio were more evident in period 3 in favour of the commercial and in period 4 in favour of the pedigree.

(2) Under cages 'C'

Figure 15 (page 95) shows the total dry matter yield of herbage at consecutive sampling dates on both swards. The difference from Figure 13 (page 85) , in which the commercial was above the pedigree in periods 3 and 4 , may be due to the greater susceptibility of the commercial to severe cutting.

Table 39 shows that the total yield on the pedigree plots in all but the first period was superior . Appendix 19 (b) gives yields for each sample date.

TABLE 39 DRY MATTER - (x 100 lbs.) PER ACRE - 'C' -1958

Period	Sown	Plot	Cor. D.M.	Sown grass	Other grass	Other weeds
1	Spring '57	7A	47	46	1	
		7B	50	50		
2		7A	17	16	1	
		7B	15	14		1
3		7A	81	60	20	1
		7B	77	64	12	1
4		7A	42	18	18	6
		7B	34	25	9	
Total		7A	187	140	40	7
		7B	176	153	21	2

Over the year the pedigree plots yielded 1100 pounds dry matter more than the commercial or about 6 per cent . Percentages of sown species in periods 1 and 2 were the same on both swards but greater in 3 and 4 on the commercial as per Table 40 (page 97).

TABLE 40 PERCENTAGE DRY MATTER - 'C' - 1958

Period	Plot	Leaf	Stem	Sown grass	Other grass	Other weeds	Burn & soil
1	7A	90.4	8.1	98.5	1.1	0.4	
	7B	87.2	12.4	99.6	0.2	0.2	
2	7A	36.9	54.2	91.1	7.1	1.8	
	7B	25.1	67.7	92.8	1.9	5.3	
3	7A	26.6	43.8	70.4	23.4	0.8	5.4
	7B	31.8	46.4	78.2	14.5	0.9	6.4
4	7A	34.1	8.5	42.6	42.6	12.5	2.3
	7B	45.6	19.0	64.6	21.5	1.2	12.7

This latter condition is due largely to the difference in botanical composition between the sites on both swards where the pedigree sites were also quite atypical of the A sub-plot.

(b) Percentage Nitrogen of Herbage

The quality of herbage as per cent nitrogen is given in Table 41.

TABLE 41 - PERCENTAGE NITROGEN - HERBAGE DRY MATTER - 'O' and 'C' - 1958

Period	'O'		'C'	
	7A	7B	7A	7B
1	3.37	3.26	3.27	3.03
2	3.59	3.56	2.61	2.24
3	2.69	2.69	2.21	2.32
4	2.51	2.55	2.42	2.82

Under grazing conditions herbage quality was only slightly higher

during period 1 on the pedigree , and was similar to it for the rest of the year ; under cages the pedigree was superior during periods 1 and 2 and the commercial better over periods 3 and 4. Values under cages are lower than under grazing for both varieties , these results being similar to plot 3 - Table 32 (page 90) . This could be attributed to the effect of faecal returns under grazing , since recovery periods were at times equal to or greater under grazing than cages.

(c) Soil data

Soil carbon and nitrogen figures are shown in Table 42.

TABLE 42 PER CENT SOIL CARBON AND NITROGEN - 1958

Plot	% C			% N		
	March '58	Nov. '58	% Incr.	March '58	Nov. '58	% Incr.
7A	2.13	2.30	8.0	0.258	0.31	20.2
7B	2.18	2.36	8.2	0.263	0.32	21.7

The figures show normal increases and if anything the values are slightly in favour of the commercial sward.

(d) Intake studies

Table 43 gives the amount of dry matter on offer/the total together with and the daily live-weight gains for the five animals during the trials.

TABLE 43 DRY MATTER - TOTAL AND DAILY LIVE-WEIGHT GAINS -POUNDS-1958

Date	Intake	7A			7B		
		Her.D.M. lb.	Tot.L.W. Gain-lb.	Gain Day lb.	Her.D.M. lb.	Tot. L.W. Gain-lb.	Gain Day lb.
July 14-25	1	3903	153	12.8	4208	154	12.8
October 22-31	2	4681	98	8.2	5210	28	2.3

Even when the total yield on offer was greater on the commercial plots at similar nitrogen values , more live-weight returns were obtained from the pedigree sward. It was observed that , in the first trial especially , the faeces on the commercial sward was much softer than on the pedigree. Determinations of faecal organic matter production showed no difference in output. The dry matter intake also showed no differences nor did digestibility of herbage - Table 44.

TABLE 44 - DRY MATTER INTAKE AND FAECAL ORGANIC MATTER PRODUCTION. POUNDS PER BULLOCK PER DAY - 1958

Intake	Dry Matter Intake - lbs.		Faecal Organic Matter - lbs.	
	7A	7B	7A	7B
1	12.3	13.3	3.0	3.1
2	16.1	16.1	3.6	3.4

Tables 43 and 44 show that there was more efficient conversion of the pedigree plots into body-weight and show the lowering of herbage quality from July to October. Digestible organic matter intake converted into starch equivalent bears this out more clearly and shows better utilisation on the first trial - Table 45.

TABLE 45 - ESTIMATED STARCH EQUIVALENT REQUIREMENT AND INTAKE - POUNDS PER BULLOCK PER DAY - 1958

Requirements	Intake			
	1		2	
	7A	7B	7A	7B
Maintenance	4	4	5	4.9
Grazing	1	1	1	1
Growth -				
1.8 lb/day gains	4.608	4.608		
2.0 " " "			3.28	0.92
Total	9.608	9.608	9.28	6.82
Intake lb. S.E.	9.531	10.332	11.68	11.47
Differences	+0.067	-0.724	-2.40	-4.65

(e) Live-weight data

Table 46 gives the total live-weight returns during the year with starch equivalent values.

TABLE 46 LIVE-WEIGHT INCREASE AND ANIMAL STARCH EQUIVALENT - (x 100 lbs.) - 1958

Plot	Live-weight gain - lbs.				Live weight S.E. (x 100 lbs.)
	Ewes	Lambs	Tegs	Calves	
7A	-292	536	48	367	5392
7B	-457	396	100	316	4530

The ewes inevitably lost weight due to lambing but the gain of lambs and calves is greater on the pedigree sward. The short intake studies fit into this general picture.

(f) Discussion

The earliness of the commercial under grazing and cages is further shown here. Under the former there was a 10 per cent difference in favour of the commercial , which was reversed to 7 per cent in favour of the pedigree under cages. Weeds were again more numerous in the commercial. The figures suggest a more efficient conversion of the pedigree herbage into live-weight gain.

General Discussion - Experiment II - 1958

The indications which seem to emerge from the Italian ryegrass swards are as follows :-

Under grazing,yields of S 22 and Irish sown in autumn and spring are similar , and the ability of the Irish to come away quicker in the spring , at least to early June , is shown in both first and second year swards. The ability of the spring sowings to establish themselves quickly is an advantage especially when weeds are likely to be a problem ; these plots

also had a higher herbage nitrogen value. Under cages there were greater differences between both varieties with increases of 20 and 6 per cent respectively in the yields of pedigree and commercial over the autumn sown plots. On the spring-sown sward , leaf-stem ratios more openly favour the peidgree spring-sown sward than in the other two sowings. The herbage under grazing was invariably of higher quality than that under cages but extending the grazing interval over six weeks reversed the picture.

The live-weight data are open to much criticism , since they are measured over relatively short periods and fill could account for much of the differences though by weighing at the same time (9:00 a.m.) on and off plots much of this variation should have been overcome. The pedigree variety seems to have been more efficiently converted into animal live weight than the commercial. This is borne out by the two intake studies undertaken in which the digestibility and herbage organic matter intake were the same.

On both intake estimations there was more feed available than was needed , so that , without a difference in digestibility , the technique could not be more critical.

The actual soil carbon values show a normal 8 per cent increase in the older swards ; that in the younger swards was more erratic with greater values in spring-sown plots to autumn and in pedigree to commercial swards.

GENERAL DISCUSSION

A comparison of commercial and pedigree varieties of grasses has been undertaken using three species - perennial ryegrass , Italian ryegrass and cocksfoot - with a view to evaluating , from leys of varying ages , any differences in productivity in terms of dry matter production and of animal live-weight gains. Although it was not possible to make a direct

comparison between cutting and grazing managements from the data , certain trends have been noted which were specific for a variety . There were however degrees of difference between species.

On the whole the pedigree varieties show greater persistence than the commercial . The difference is greater on the perennial ryegrass swards in experiment 1 : the Irish in its second harvest year showed a marked decline. On the cocksfoot plots as on the first and second year Italian ryegrass swards the differences were less obvious. Irish Italian ryegrass,both in its second year and as autumn undersown , was more productive in the spring than S 22 as was Danish cocksfoot as against S 37.

In the case of perennial ryegrass the pedigree yielded consistently more as a result of the dying out of the Irish . As the season progressed the differences in periods 3 and 4 became smaller ; on the clover swards the greater amount of clover in the commercial swards helped. Under cutting the increase of white clover and weeds at the expense of burn both helped to maintain a more even clover stand in the perennial ryegrass plots without appreciably reducing the sown grass stand. In a similar way the Irish commercial on the pure grass plots gave way to weeds under cutting more than did S 24.

On the cocksfoot plots a similar trend in yield was noted : the clover also increased more under cutting but the pedigree grass gave way more to weeds as a probable result of its less shading effect. The decrease in cocksfoot under cutting was more marked than that in the ryegrasses . Leaf-stem ratio and herbage nitrogen values reflect comparative management and stage of utilisation of herbage and the success of attempts to equate clover-nitrogen.

It is apparent from the results that the very significant differences

in herbage nitrogen values in favour of the no-clover swards during periods 1 and 2 in experiment 1 were due to the higher available nitrogen and , to some extent , to the stage of growth of the grass. The fact that leaf-stem ratio tended to follow this pattern also helped to confirm these assumptions. Grazing seems to modify these differences. It may be possible to use the amount of burn on plots as a measure of the quality of herbage , as it was shown that more burn occurred on plots with the lower nitrogen value.

The much greater nitrogen differences under grazing in the case of perennial ryegrass was due to the differences in degree of utilisation of these swards ; when the clover plots were producing more herbage , they were never completely utilised , whereas the nitrogen plots were. The nitrogen status of the latter would therefore be higher. On the grazed cocksfoot swards utilisation was never very different ; and both leaf-stem ratio (hence presumably stage of growth) and nitrogen values were similar throughout.

In the absence of much clover on the cocksfoot-clover swards and with the animal effect , the very significant pure grass herbage nitrogen values under cutting (clover-no-clover) is not surprising. The herbage nitrogen values under cutting give the best indication of herbage quality here . The commercial was superior throughout the year on the cocksfoot swards while on the perennial ryegrass S 24 was superior to September and the commercial from September to mid-November ; in all cases higher quality was associated with higher growth rate.

Three important factors arose :-

(1) The first is the need to add at the right time the same amount of nitrogen (in the form of artificials) as the clover nitrogen released in the sward which was not as high as the (6) six cwts. Nitro-Chalk applied

to the end of June ; half this amount may be enough. The differences in response of varieties between ryegrass and cocksfoot may be due to the low proportion of Irish to S 24 (in the cocksfoot swards Danish and S 37 were more comparable)and to some proportion of the fertiliser applied being wasted before utilisation because the population of herbage was more sparse.

In period 3 the greater differences between the commercial clover and no-clover swards appear as a result of the larger amount of clover then in the swards. In period 4 the advantage was in favour of all corresponding clover swards except the commercial cocksfoot sward. A reduction of the August application of fertiliser by $\frac{1}{2}$ hundredweight per acre to be applied in September may help to simulate the clover-nitrogen release at this point.

(2) The second factor is the difficulty of maintaining comparable clover stands in both varieties because of differences in persistence of the sown grasses . A lower grazing management would materially help , but not one so low as to simulate the cutting technique , which tends to increase the killing out of the commercial variety.

(3) The third point is the difference in degree of utilisation which influences quality of the herbage. Although on a dry matter basis differences are also reflected under the cutting management , the live-weight returns tend to reflect the opposite to the dry matter figures rather showing a positive relationship with the quality of the sward on offer.

The animal return figures from experiment 1 reflect this point : the higher producing pedigree varieties produce less live weight than the commercial , the quality of the grass remaining higher than the pedigree , which always had some older material on offer. The higher clover percentage of the commercial swards meant that better herbage was always on offer. In experiment 11 the live-weight returns favoured the pedigree swards ;

even though the period was short this tendency was in keeping with the trends for that experiment , where herbage quality was more comparable than in experiment 1. With no difference in intake and digestibility the indication is that a similar result may be obtained in experiment 1 were conditions more equal.

The greatest live-weight gains were obtained from swards before mid-June; gains then fell rapidly to the level of maintenance after September . The earlier growing grasses should therefore give higher live-weight gains throughout the year if differences in spring yield are great enough. It is also possible that the pedigree swards with their more prostrate habit are more efficient converters of incident light energy and could grow faster than the commercial under conditions which were insufficient for optimum growth of the latter.

The higher yields of the pedigree swards may mean that they could have carried more stock or could have been cut more often so as to give higher yields and higher nitrogen returns , that is the judgment of pasture management by eye is not accurate enough to pick up the small differences which exist. This would indicate that more than one stocking rate is required to pick up such differences.

The sampling techniques adopted seem adequate and further replication may have made significant differences.

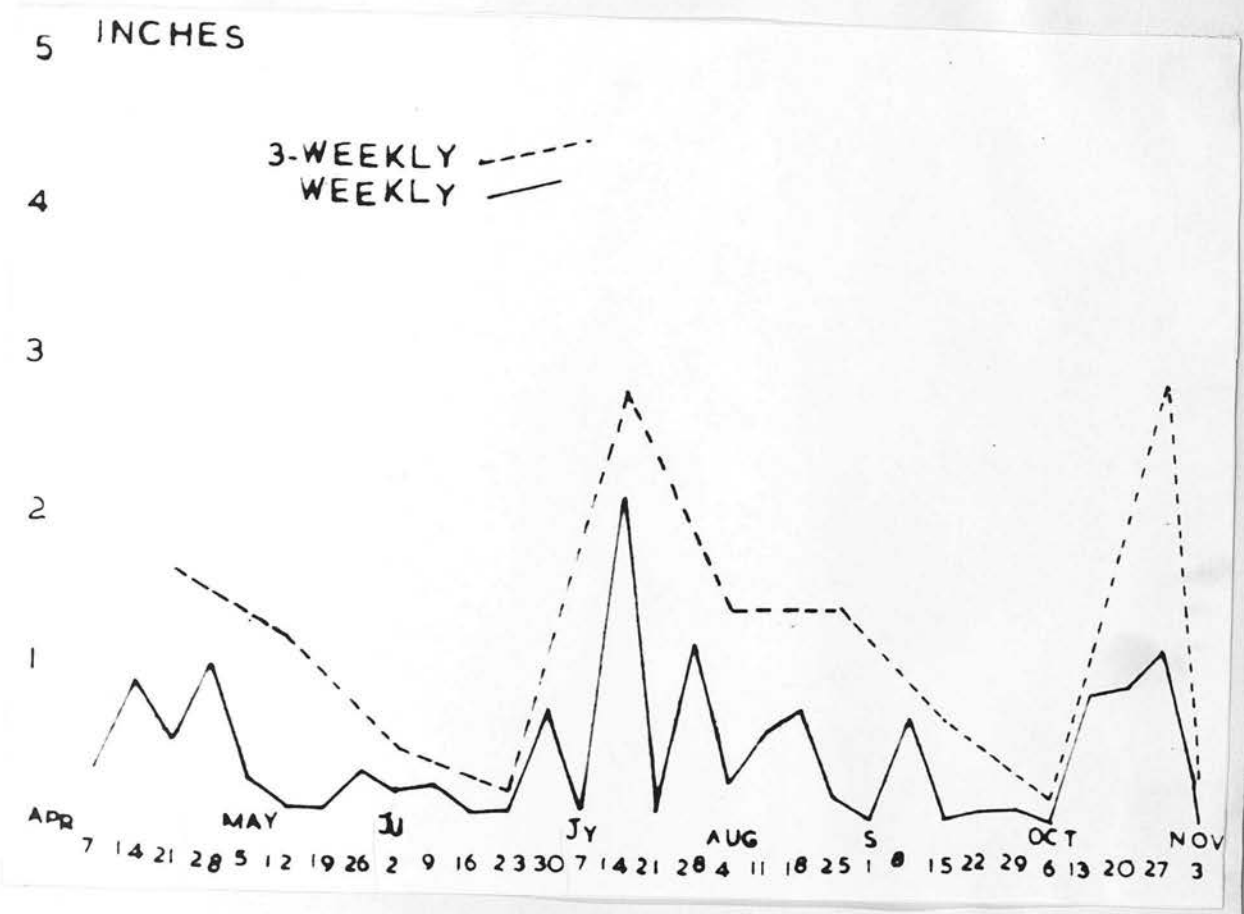
RESULTS - 1959

5. RESULTS - 1959

1. Weather

Figure 16 shows rainfall from April 1 to November 4 , 1959.

FIGURE 16 - RAINFALL - 1959



This was a "very dry"year and although 12.86 inches of rain fell as compared with 14.24 inches over the corresponding period in 1958 most of it fell either when low temperatures retarded growth or when , due to high soil moisture deficit during the year , precipitation was insufficient . The season was earlier than in 1958 and grazing started in experiment 1 on April 9.

17. EXPERIMENT 1 - FUGDOWN 1 - H 138

A. Herbage utilisation

Figure 17 shows method of utilisation.

FIGURE 17 - HERBAGE UTILISATION - 1959

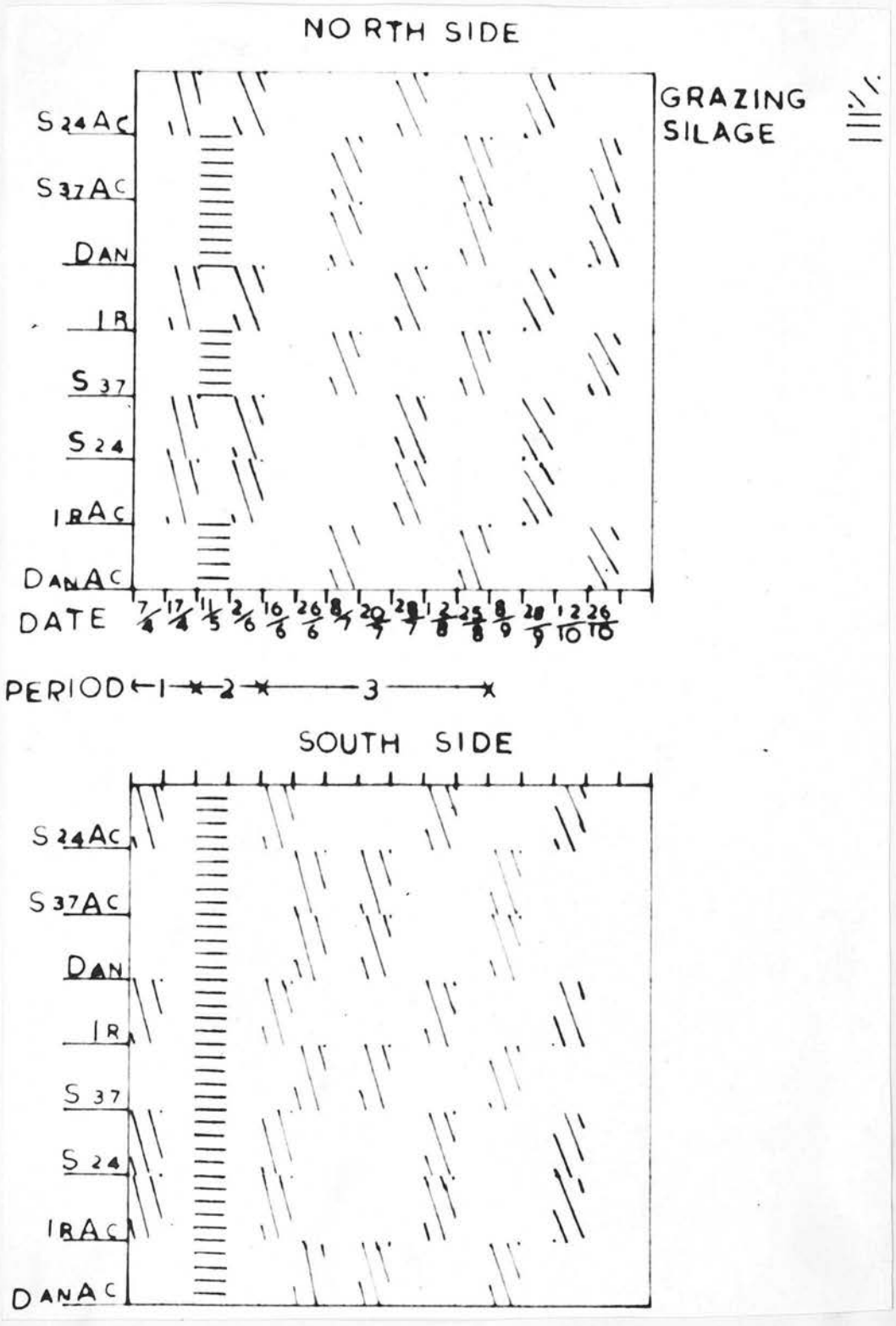


FIGURE 18 - PLOT DRY MATTER - PERENNIAL RYEGRASS - '0'

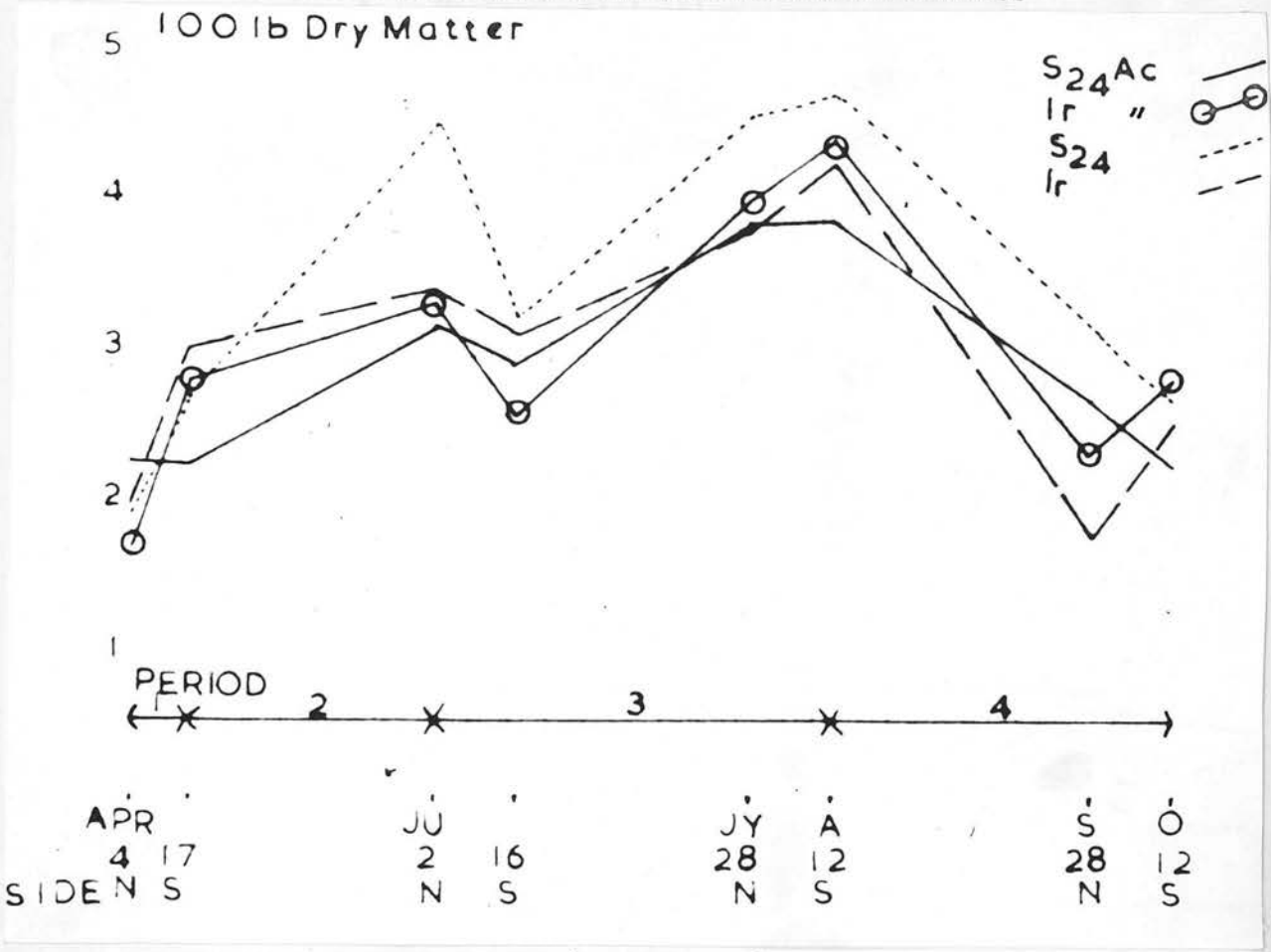


TABLE 47 - DRY MATTER (x 100 lbs.) PER ACRE - '0'

Period	Plot	Cor D.M./acre	White Clover	Sown Grass	Other Grass	Other Weeds
1	S24Ac	23	1	21	1	
	IrAc	25	2	19	4	
2	"	16		11	5	
	"	17	1	5	11	
3	"	56	3	40	13	
	"	55	5	25	24	1
4	"	26	1	19	6	
	"	26	3	4	19	
TOTAL	S24Ac	121	5	91	25	
	IrAc	123	11	55	56	1

The division into 4 periods similar to 1958 is as follows :-

Period	1	April	7	- May	11	- Spring growth
"	2	May	12	- June	2	- Seeding stage
"	3	June	3	- August	25	- Summer growth
"	4	August	26	- October	26	- Autumn "

Ryegrass plots were grazed over the 4 periods , cocksfoot only over periods 3 and 4 .

B. Perennial Ryegrass

(a) Yields under grazing - '0'

Figure 18 (page 108) shows yields of dry matter on plots during the year.

1. Grass-clover

Analysis of dry matter available on these plots is shown in Table 47 on page 108.

Sown grass was over 66 per cent more on the pedigree swards while white clover and unsown grass species were both over 50 per cent more on the commercial. The difference in total dry matter production is not significant as per Table 48 below which also shows significant levels for each period.

TABLE 48 - DRY MATTER (x 10 lbs.) MEAN YIELDS AND STANDARD ERROR - '0'

Period	S24Ac	IrAc	S24	Ir	S.E. of means of 3
1	233.8	248.4	239.0	261.6	± 11.92
2	165.0	173.0	238.0+	178.0+	± 13.3
3	555.0	549.0	654.0	585.0	± 40.4
4	256.0	264.0	305.0	223.0	± 24.7
1-4	1210.0	1235.1	1210.0	1247.6	± 48.6

+ 0.05 level significance

FIGURE 19 PLOT DRY MATTER (x 100 lbs.) - 'C' - INTERRUPTED GROWTH

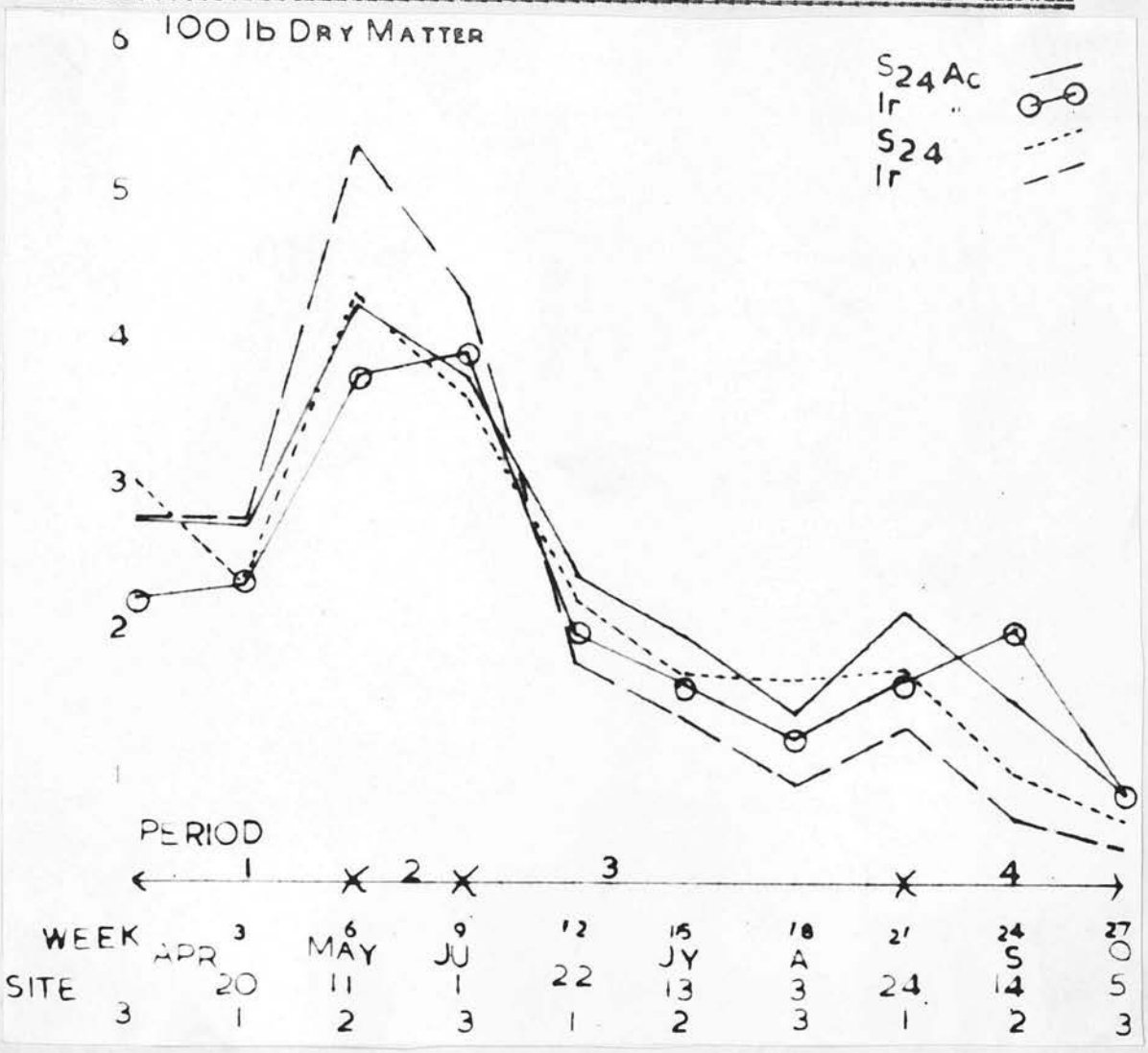


TABLE 50 - DRY MATTER (x 100 lbs.) PER ACRE 'C' - INTERRUPTED GROWTH

Period	Plot	Cor D.M/ac	White clover	Sown grass	Other grass	Other Weeds
1	S24Ac	51	2	35	14	
	IrAc	43	3	20	20	
2	"	20	1	11	7	1
	"	21	1	6	14	
3	"	41	2	31	8	
	"	34	3	12	14	5
4	"	12	1	7	4	
	"	15	3	1	9	2
Total	S24Ac	124	5	84	33	1
	IrAc	114	10	39	57	7

2. "Pure" Grass

Table 49 below shows more than 15 per cent higher production on the pedigree swards which contained more than 100 per cent more sown grass than the commercial plots.

TABLE 49 - DRY MATTER (x 100 lbs.) PER ACRE - ' 0'

Period	Plot	Cor. DM/ac.	Sown Grass	Other Grass	Other Weeds
1	S24	24	23	1	
	Ir	26	21	5	
2	"	24	18	6	
	"	18	8	10	
3	"	66	52	14	
	"	59	23	34	2
4	"	30	28	2	
	"	22	6	16	
Total	"	144	121	23	
	"	125	58	65	2

Weed grasses were nearly 300 per cent more on these latter plots. Varietal differences during the year were not significant (Table 48 on page 109) . Of all treatments the pedigree + nitrogen was the most productive .

(b) Perennial Ryegrass - 'C'

1. Grass-clover

The two treatments will now be distinguished by reference to the old as ' interrupted ' and the new as 'uninterrupted ' . Figure 19 and Table 50 (on opposite page , 110) show yields under the previous (interrupted) cutting regime. An overall slight increase in yield (nearly 9 per cent) is shown on the pedigree plot , which was not

FIGURE 20 PLOT DRY MATTER (x 100 lbs.)- 'C' - UNINTERRUPTED GROWTH

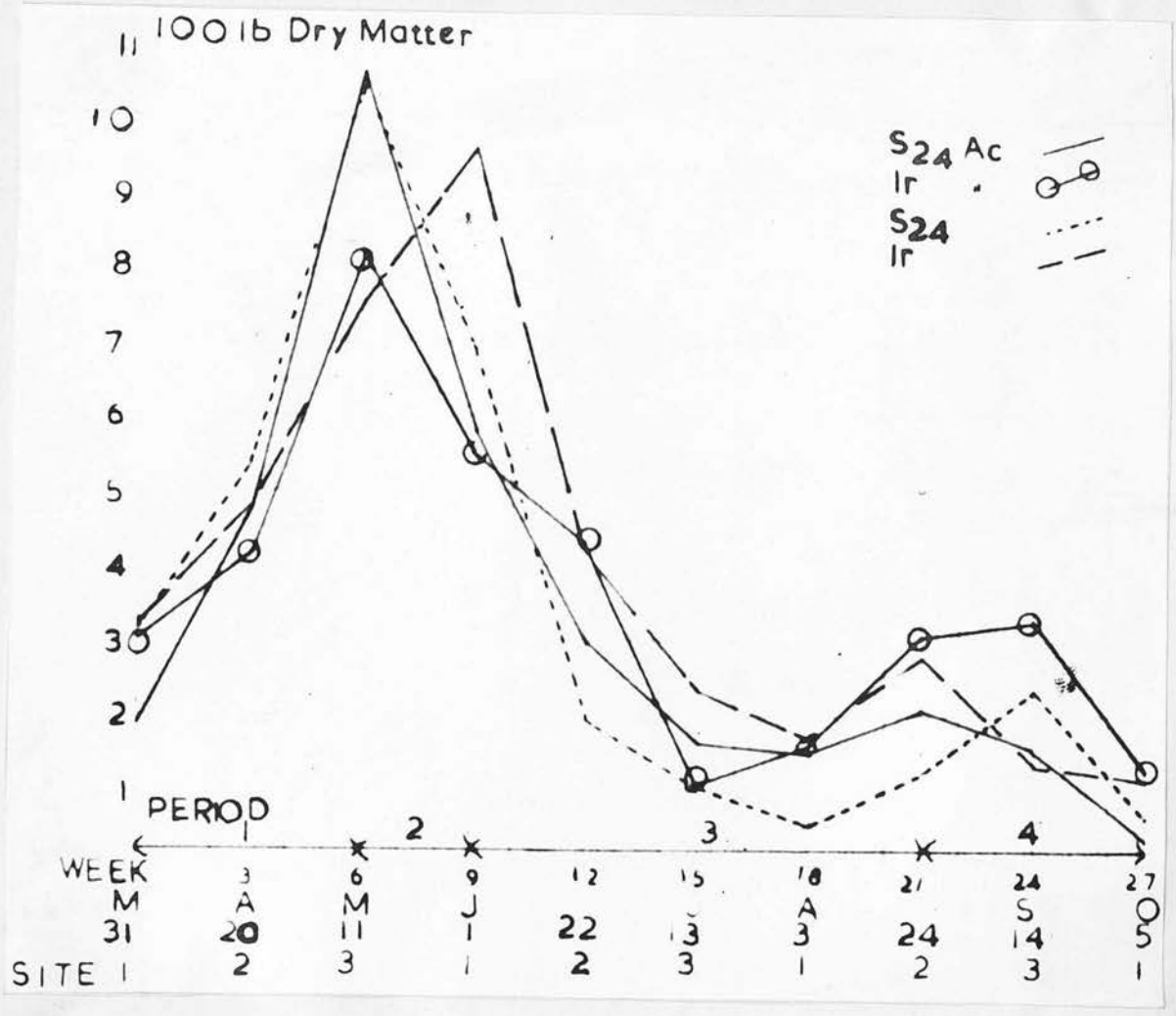


TABLE 52 DRY MATTER (x 100 lbs.) PER ACRE - 'C' - UNINTERRUPTED GROWTH

Period	Plot	Cor D.M/ac	White Clover	Sown Grass	Other Grass	Other Weeds
1	S24Ac	92	T	73	19	
	IrAc	81		26	55	
2	"	31	T	25	6	
	"	30	1	6	23	
3	"	44	T	38	6	
	"	53	2	21	13	17
4	"	10	T	7		3
	"	24	1	1	18	4
Total	S24Ac	177	T	143	31	3
	IrAc	188	4	54	109	21

significant (Table 51 below).

TABLE 51 - DRY MATTER (x 10 lbs.) - MEAN YIELDS AND STANDARD ERROR-

' C ' - INTERRUPTED GROWTH

Period	S24Ac	IrAc	S24	Ir	S.E. of means of 3
1	504.0	438.0	510.0	438.0	± 41.1
2	197.0	206.0	190.0	225.0	± 28.9
3	414.0+	341.0	385.0+	285.0	± 33.1
4	125.0+	151.0+	89.0	63.0	± 18.5
1-4	1240.5	1135.3	1173.6	1146.8	± 82.0

+0.05 level significance

The total amounts of sown grass and clover are greater under cutting conditions , but the relationships are similar under both managements. Where growth is uninterrupted the pedigree swards gave greater yields in spring and less during summer and autumn (Figure 20) as a result of the larger number of unsown species on the commercial swards (Table 52 , page 112) .

The overall 6 per cent difference in yield in favour of the commercial swards was due to weeds.

2. " Pure"Grass

Interrupted growth yields are shown in Figure 19 (page 110) and Table 53 (page 114). There was double the yield of sown grass on the pedigree swards here as there was under grazing , unsown species in all cases tended to even dry matter production of both varieties under uninterrupted growing conditions (Figure 20) .

TABLE 53 - DRY MATTER (x 100 lbs.) PER ACRE - ' C '

INTERRUPTED GROWTH

Period	Plot	Cor. DM/ac	Sown Grass	Other Grass	Other Weeds
1	S24	51	42	9	
	Ir	57	29	28	
2	"	19	15	4	
	"	23	6	17	
3	"	38	31	5	2
	"	29	11	15	3
4	"	9	6	2	1
	"	6	1	5	
Total	"	117	94	20	3
	"	115	47	65	3

With a greater contribution from unsown grass , the commercial swards yielded much more in periods 2 and 3 (Table 54 below) .

TABLE 54 - DRY MATTER (x 100 lbs.) PER ACRE - ' C '

UNINTERRUPTED GROWTH

Period	Plot	Cor. DM/ac	Sown Grass	Other Grass	Other Weeds
1	S24	101	55	46	
	Ir	83	24	59	
2	"	37	22	15	
	"	51	13	38	
3	"	25	20	5	
	"	59	16	43	
4	"	16	9	3	4
	"	13	1	12	
Total	"	179	106	69	4
	"	206	54	152	

TABLE 55 PERCENTAGE DRY MATTER - PERENNIAL RYEGRASS -'O' & 'C' -1959

Period	Management	Plot	Sown Grass	White Clover	Other Grass	Other Weeds	Burn and Soil
1	Grazing 'O'	S24Ac	82.0	4.0	3.2		10.8
		IrAc	69.8	6.3	14.6		9.3
2		"	52.6	2.1	23.9		21.4
		"	25.4	6.7	50.9		17.0
3		"	51.0	5.1	19.6	T	24.3
		"	32.8	10.3	27.9	1.6	27.4
4		"	39.9	1.2	13.4		45.5
		"	12.8	7.4	39.1	T	40.7
1	No Grazing 'C' Interrupted Growth	"	64.2	3.1	24.8		7.9
		"	41.2	6.6	42.8	T	9.4
2		"	45.3	5.0	32.4	2.6	14.7
		"	22.1	3.0	52.3	1.0	21.6
3		"	55.7	3.5	15.0	T	25.8
		"	26.8	6.7	29.7	9.4	27.1
4		"	44.2	3.6	21.3	5.4	25.5
		"	7.6	14.8	49.7	15.4	12.5
1	No Grazing 'C' Uninterrupted Growth	"	67.5	T	18.0		14.5
		"	24.0		50.7		25.3
2		"	68.5	T	16.7		14.8
		"	19.5	1.4	69.4		9.7
3		"	66.6	T	10.4		23.0
		"	33.3	3.6	20.8	27.0	15.3
4		"	53.6	T	1.8	19.6	25.0
		"	2.8	4.5	50.9	11.9	29.9
1	Grazing 'O'	S 24	86.2		4.0	0.3	9.5
		Ir	74.9		15.4	1.2	8.5
2		"	64.1		22.4		13.5
		"	29.6		39.4	0.9	30.1
3		"	56.2		13.3	T	30.5
		"	26.3		43.9	1.4	28.4
4		"	49.1		5.0		45.9
		"	14.9		33.3	1.9	49.9

contd.

TABLE 55 contd.

Period	Management	Plot	Sown Grass	White Clover	Other Grass	Other Weeds	Burn and Soil
1	No Grazing 'C' Interrupted	S 24	69.9		16.1		14.0
		Ir	43.7		43.1		13.2
2	Growth	"	65.8		16.1		18.1
		"	23.4		62.9		13.7
3		"	60.2		9.5	4.3	26.0
		"	26.6		36.4	5.9	31.1
4		"	47.0		11.7	3.2	38.1
		"	15.4		55.3	2.3	27.0
1	No Grazing 'C' Uninterrupted	"	45.4		37.6		17.0
		"	24.1		59.0		16.9
2	Growth	"	49.2		35.4		15.4
		"	22.1		63.6		14.3
3		"	43.9		12.3		43.8
		"	23.0		61.6		15.4
4		"	23.4		11.1	12.9	42.6
		"	4.0		70.0		26.0

Table 55 above shows percentage contribution of the various constituents under all three managements . There was a greater contribution from sown species under grazing than under cutting ; persistence was greater in the case of the pedigree variety. Clover increased under the interrupted regime more than under grazing , but where there was no topping , clover almost disappeared due to competition. The commercial ryegrass was also more depressed by the new cutting treatment.

Figures for leaf-stem analysis are shown for each period in Table 56 (page 117) .

TABLE 56 - LEAF-STEM RATIO - PERENNIAL RYEGRASS - 1959 - LOG 100x

Period	Management	Treatment				S.E. of Means of 3
		S24Ac	IrAc	S24	Ir	
1	Grazing	0.6	0.6	0.7	0.8	± 0.08
2	'O'	1.8	1.6	1.5	1.6	± 0.15
3		2.1	2.0	2.3	2.1	± 0.11
4		0.3	0.4	0.3	0.4	± 0.06
1	No Grazing	0.4	0.3	0.3	0.2	± 0.12
2	'C'	1.7++	1.4	1.6++	1.4	± 0.06
3	Interrupted	2.2+	1.9	2.1+	1.8	± 0.12
4	Growth	0.3	0.4	0.4	0.4	± 0.11
1	No Grazing	2.0	1.9	2.0	1.8	
2	'C'	1.4	1.2	1.6	1.1	
3	Uninterrupted	2.0	1.8	2.1	1.8	
4	Growth	2.6	2.0	2.4	2.5	

TABLE 57 - HERBAGE NITROGEN PER CENT - PERENNIAL RYEGRASS - 1959

Period	Management	Plot				S.E. of Means of 3
		S24Ac	S24	IrAc	Ir	
1	Grazing	3.18	3.31	3.18	3.27	± 0.15
2	'O'	1.90	1.93	1.97	1.94	± 0.06
3		1.85	2.02	2.63+	2.12+	± 0.15
4		1.86	2.13	2.25++	2.24++	± 0.05
Total		8.78	9.39	10.04	9.57	± 0.31
1	No Grazing	2.35	2.53	2.60	2.47	± 0.05
2	'C'	1.70	1.63	1.74	1.64	± 0.04
3	Interrupted	2.10	2.07	2.32	2.16	± 0.12
4	Growth	2.44	2.48	2.77	2.53	± 0.13
Total		8.60	8.71	9.44	8.80	± 0.28
1	No Grazing	2.16	2.37	2.26	2.68	
2	'C'	1.35	1.81	1.54	1.68	
3	Uninterrupted	1.92	2.28	2.55	2.48	
4	Growth	2.24	2.30	2.40	2.43	

\+ 0.05 level significance
++ 0.01 " "

There were no significant differences under grazing but a varietal difference occurred in periods 2 and 3 under the old cutting treatment when the commercial variety was appreciably stemmier. Under all treatments swards were fairly uniform throughout the year.

(c) Per cent nitrogen in the herbage

Table 57 opposite shows herbage nitrogen per cent on all swards during the year. Under grazing , values on the pedigree pure grass swards were higher than on the pedigree clover ones , apparently as a result of the low clower content of the latter. On the commercial plots, values were similar and in period 3 clover may have been responsible for the higher nitrogen values on those swards. The varietal differences in periods 3 and 4 were significantly in favour of the commercial swards.

The values for the cutting treatments reflect clover proportions where cutting occurred , higher on the commercial and lower on the pedigree clover swards. The disappearance of clover where growth was uninterrupted may have caused the lower values observed on the clover as against the nitrogen swards earlier in the season. It is felt that the high proportion of weeds did not always cause the nitrogen values to be related to the leafiness of the swards.

(d) Intake Studies

Two estimations were made as in the previous year. Table 58 (page 119) shows live-weight gain , herbage on offer and quality on both occasions. The indications are again that live-weight increase was largely influenced by herbage quality especially in spring. In the autumn the amount of herbage eaten appeared to be more important.

TABLE 58 - LIVE-WEIGHT INCREASE , DRY MATTER PER PLOT AND HERBAGE NITROGEN PER CENT

Treatment	Intake Studies					
	1 4.6. - 18.6.			2 28.7.- 13.8.		
	L.W.I. (lb.)	Plot D.M. (100 lb.)	% N Herbage	L.W.I. (lb.)	Plot D.M. (100 lb.)	% N Herbage
1: C + N	(2) 39	(3) 3.14	(2) 3.01	(3) 2	(3) 2.67	(2) 2.30
2: C + Ac	(2) 39	(2) 3.47	(3) 3.00	(1) 10	(2) 2.90	(4) 1.78
3: P + N	(3) 38	(1) 4.14	(4) 2.92	(4) -4	(1) 3.13	(3) 1.98
4: P + Ac	(1) 45	(4) 2.96	(1) 3.39	(2) 8	(2) 2.90	(1) 2.40

Herbage dry matter consumed , digestibility and faecal organic matter output are shown in Table 59 below .

TABLE 59 - DRY MATTER INTAKE , DIGESTIBILITY AND FAECAL ORGANIC MATTER PRODUCTION

Treatment	Dry Matter Eaten (lb.)		Digestibility %		Faecal O.M. Output (Grams.)	
	Intake 1	2	Intake 1	2	Intake 1	2
1: C + N	(1) 3.20	(3) 2.94	(2) 69.3	(4) 67.7	(1) 405	(3) 400
2: C + Ac	(3) 2.88	(1) 3.59	(1) 69.5	(1) 68.5	(3) 363	(1) 476
3: P + N	(2) 2.92	(4) 2.90	(3) 68.8	(3) 68.0	(2) 376	(4) 392
4: P + Ac	(4) 2.39	(2) 3.12	(3) 68.8	(2) 68.3	(4) 309	(2) 418

The greater intake on the clover swards in the autumn may have been due to the greater clover content at that time. On the first trial it would appear as though the pedigree grass was more efficiently converted into body weight. Table 60 again shows the difficulty in relating ' before' and ' after ' sampling to actual intake under these conditions.

TABLE 60 - INTAKE BY THE DIFFERENCE METHOD AND BY FAECAL REGRESSION

Treatment	Before Grazing Plot D.M. (100 lb.)		After Grazing Plot D.M. (100 lb.)		Estimated by Differences D.M. (100 lb.)		Intake by Faecal N. (100 lb.)	
	Intake		Intake		Intake		Intake	
	1	2	1	2	1	2	1	2
1: C + N	3.14	2.67	1.25	2.54	1.89	0.13	3.20	1.65
2: C + Ac	3.47	2.90	1.27	2.19	2.20	0.71	2.88	2.30
3: P + N	4.14	3.13	1.82	2.57	2.32	0.56	2.92	1.62
4: P + Ac	2.96	2.90	1.15	1.72	1.81	1.18	2.39	1.75

Again there is less underestimation on the clover than on the nitrogen swards.

(e) Silage Yields

Mean yields of silage in spring are shown in Table 61 below . Both clover and pedigree swards were significantly more productive. The height of sampling may have accounted for differences with Table 47 (page 108) where differences were not significant.

TABLE 61 - MEAN YIELDS SILAGE - (x 10 lbs.) PER ACRE -

PERENNIAL RYEGRASS - 1959

Cut	Treatment				S.E. of Means of 3
	S24Ac	S24	IrAc	Ir	
Spring	311.0$^{+}_{+}$	279.0$_{+}$	270.0^{+}	186.0	± 22.0

+ 0.05 level significance

FIGURE 21 - PLOT DRY MATTER - COCKSFOOT - '0'

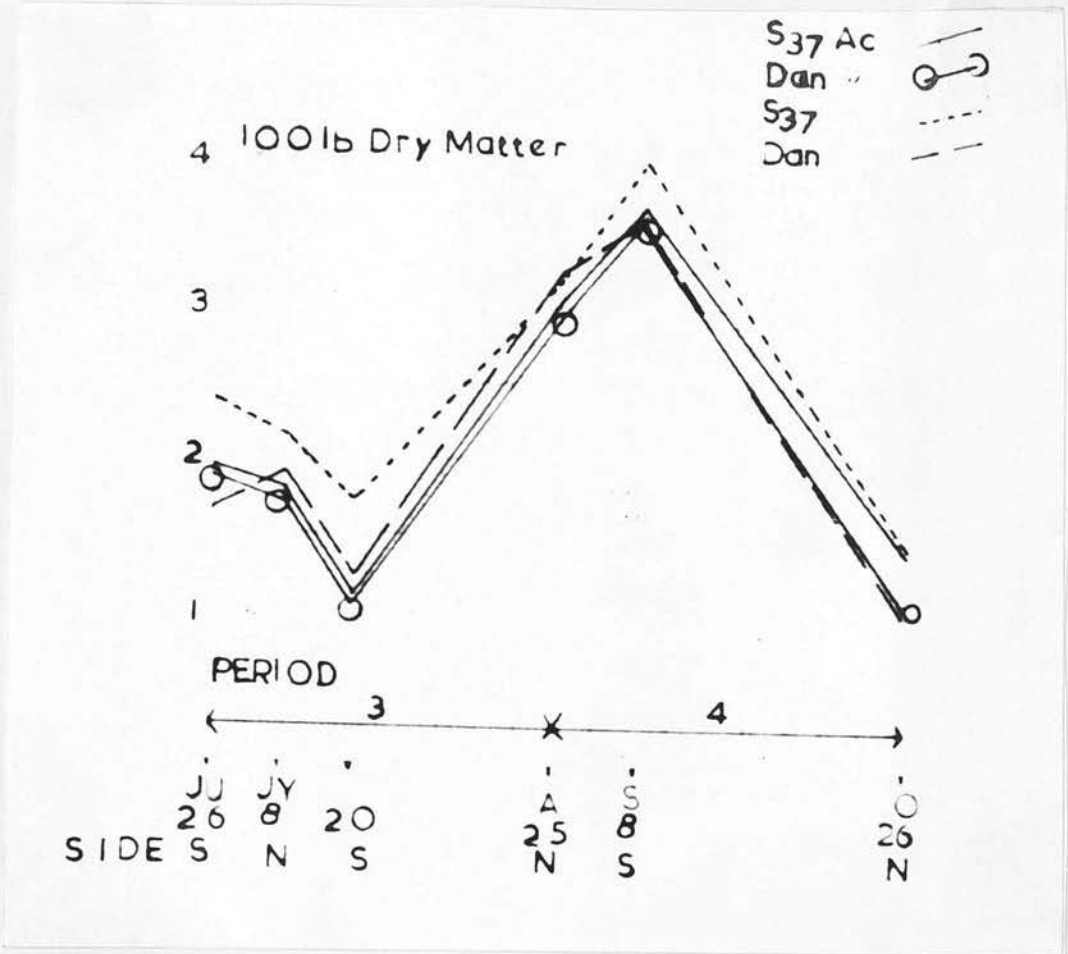


TABLE 62 - DRY MATTER (x 100 lbs.) PER ACRE - '0'

Period	Plot	Cor D.M/ac	White Clover	Sown Grass	Other Grass	Other Weeds
3	S37Ac	42	1	32	9	
	DanAc	40	1	27	11	1
4	"	27	T	22	5	T
	"	25	1	20	4	T
Total	S37Ac	69	1	54	14	T
	DanAc	65	2	47	15	1

(f) Discussion

There were no significant differences in total dry matter treatment yields under any of the sampling methods. The commercial variety was more suppressed by both cutting treatments , weeds taking its place . Clover was suppressed under the uninterrupted cutting treatment and more so on the pedigree sward. The greater weed growth on the commercial swards , especially under the cutting treatments , accounts for the difference in Figure 19 (page 110) which becomes marked from June onwards.

Leaf-stem values under grazing conditions were very similar during the year . Where the nitrogen value of the herbage cannot be related to the leafiness of the sward the clover content or weed was the modifying factor. There were small differences in the digestibilities of the herbage on both intake studies and dry matter intake and live-weight increase seemed to have been more influenced by the quality than the amount of feed on offer. The herbage sampling ' difference ' method underestimated intake. The growth rate of herbage during the period helped to increase this error.

C. COCKSFOOT

(a) Yields under Grazing - ' 0 '

1. Grass-clover

The amount of herbage on offer is shown in Figure 21 (opposite) for clover and no-clover swards. Table 62 also shows total herbage available during each period of the year on clover swards. A 6 per cent difference in total yield is similar to the previous year ; other components are also similar to 1958. Neither total nor period yields were significantly different as per Table 63 (page 123) .

TABLE 63 - DRY MATTER (x 10 lbs.) - MEAN YIELDS AND STANDARD ERROR - ' 0 '

Period	S37Ac	Dan Ac	S37	Dan	S.E. of Means of 3
3	421.0	405.0	503.0	426.0	± 43.3
4	271.0	247.0	288.0	246.0	± 20.9
3-4	692.3	651.9	790.4	672.4	± 61.8

2. "Pure" Grass

Nearly 18 per cent more dry matter was produced on the pedigree swards. Sown grass was also nearly 26 per cent more on these plots (Table 64) , with slightly more weed grasses on the commercial areas.

TABLE 64 - DRY MATTER (x 100 lbs.) PER ACRE - ' 0 '

Period	Plot	Cor. DM/ac.	Sown Grass	Other Grass	Other Weeds
3	S37	50	41	9	T
	Dan	43	33	10	
4	"	29	27	2	
	"	24	21	3	
Total	"	79	68	11	T
	"	67	54	13	

(b) Yields under Cages 'C'

Yields are shown graphically in Figure 22 (page 124) for pure grass and grass-clover swards.

FIGURE 22 PLOT DRY MATTER (x 100 lbs.) PER ACRE - 'C' INTERRUPTED GROWTH

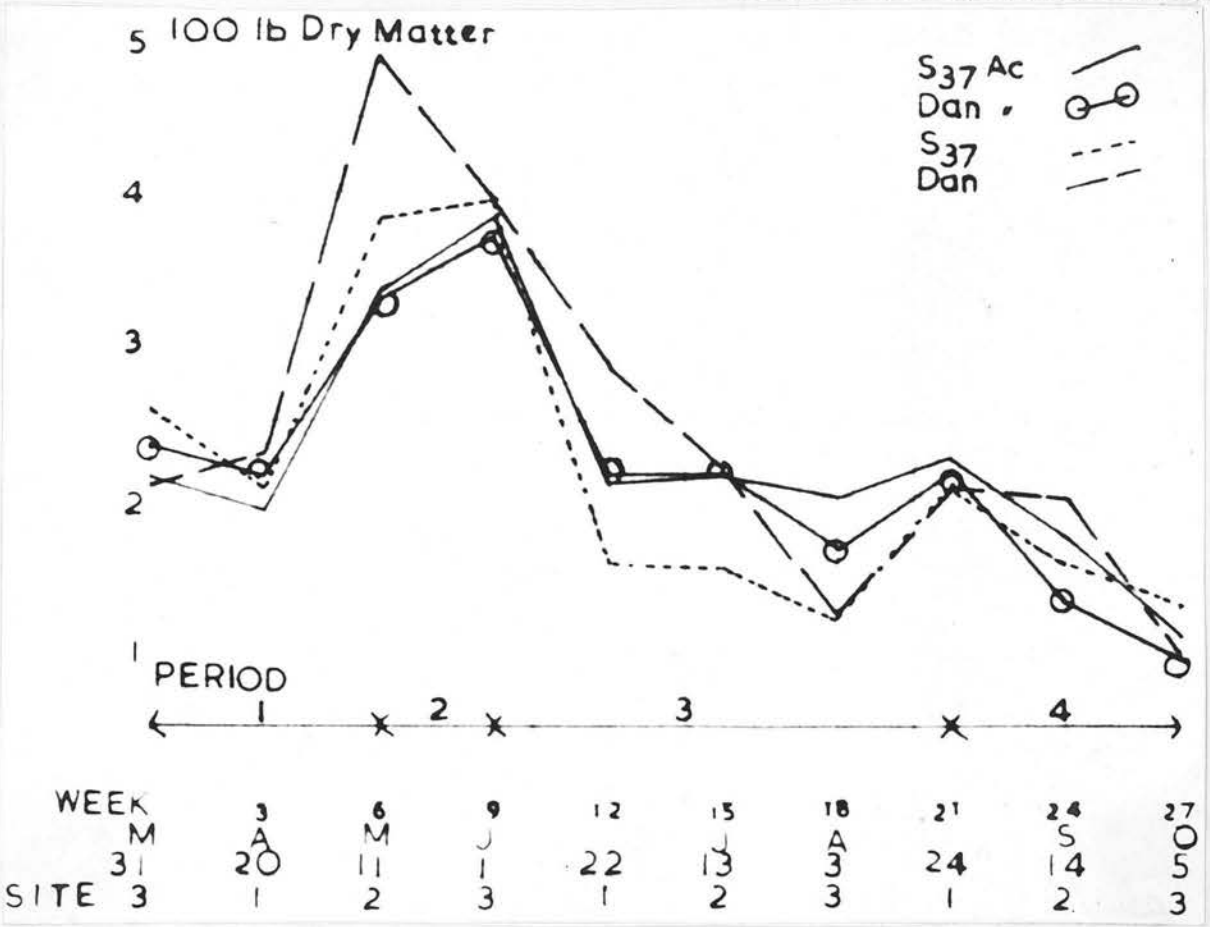


TABLE 65 DRY MATTER (x 100 lbs.) PER ACRE - 'C' INTERRUPTED GROWTH

Period	Plot	Cor D.M/ac	White Clover	Sown Grass	Other Grass	Other Weeds
1	S37Ac	40	3	15	22	T
	DanAc	41	2	13	25	1
2	"	21	2	8	11	
	"	20	1	6	11	2
3	"	45	2	29	9	5
	"	44	3	30	7	4
4	"	15	2	9	3	1
	"	12	1	8	1	2
Total	S37Ac	121	9	61	45	6
	DanAc	117	6	58	44	9

1. Grass-clover

Total yields for each period are shown in Table 65 (page 124). Total and sown grass yields were slightly better on the pedigree swards. These differences were not significant (Table 66) . There was more clover on the pedigree plots , but with both varieties amounts were low.

TABLE 66 - DRY MATTER (x 10 lbs.) MEAN YIELDS AND STANDARD ERROR - 'C' - INTERRUPTED GROWTH

Period	S37Ac	Dan Ac	S37	Dan	S.E. of Means of 3
1	399.0	414.0	450.0	495.0	± 50.7
2	204.0	199.0	211.0	210.0	± 10.1
3	452.0	434.0	340.0	445.0	± 43.6
4	150.0	119.0	152.0	159.0	± 11.8
1-4	1204.7	1166.0	1154.5	1309.0	± 91.7

Under uninterrupted growing conditions the commercial outyielded the pedigree in each period (Figure 23 and Table 67 , page 126) by nearly 20 per cent in total dry matter and by 11 per cent in sown grass. There were also more weeds on the commercial swards. Clovers disappeared owing to being smothered out.

2. "Pure" grass

Yields are shown in Figure 22 (page 124) and Table 68 (127).

Total yields were about 14 per cent higher on the commercial swards although sown grass was greater on the pedigree plots.

Yields for uninterrupted growth are shown in Table 69 (page 127).

FIGURE 23 PLOT DRY MATTER (x 100 lbs.) PER ACRE - 'C' UNINTERRUPTED GROWTH

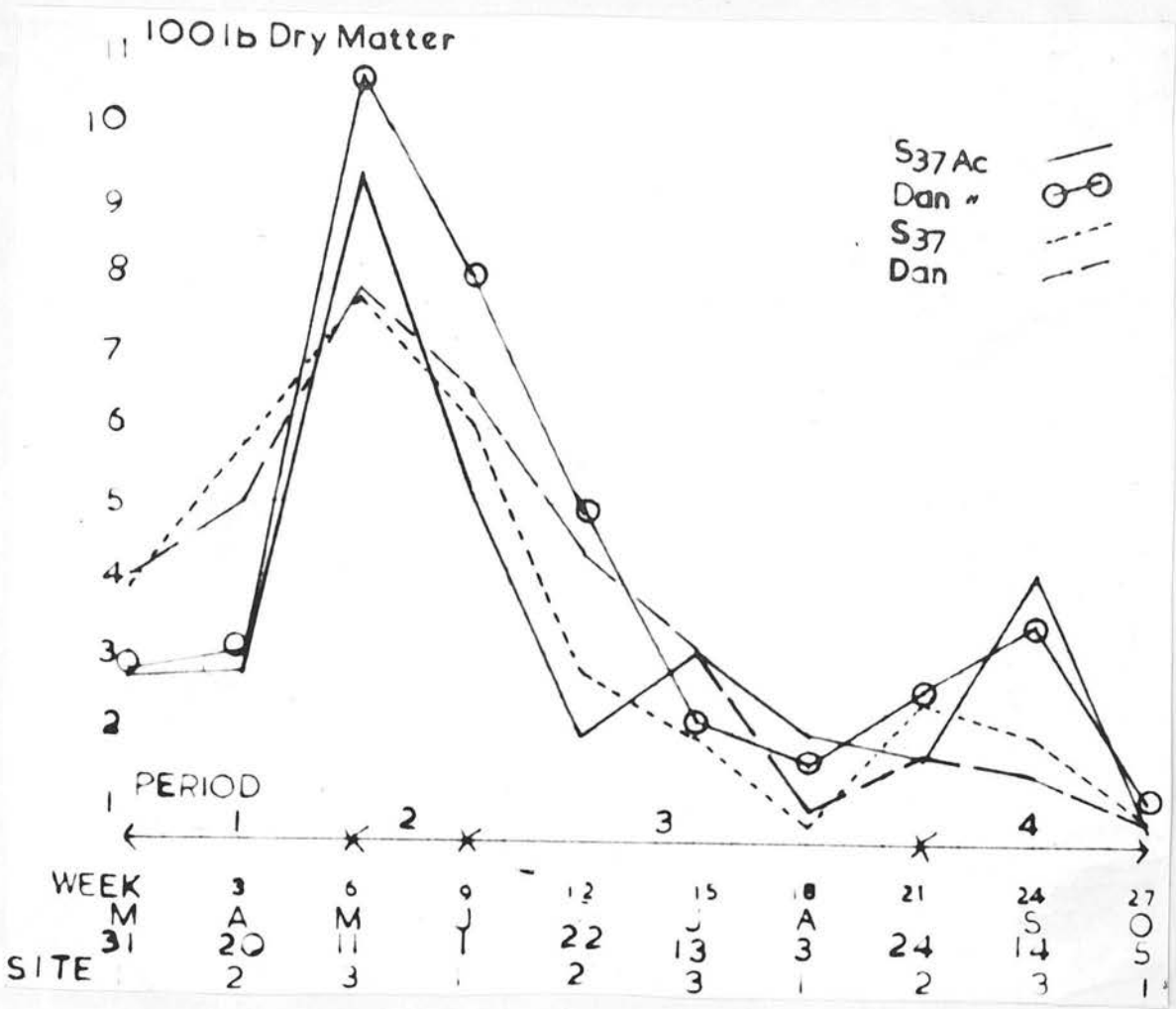


TABLE 67 DRY MATTER (x 100 lbs.) PER ACRE - 'C' UNINTERRUPTED GROWTH

Period	Plot	Cor D.M/ac	White Clover	Sown Grass	Other Grass	Other Weeds
1	S37Ac	78	T	40	38	
	DanAc	87		45	41	1
2	"	27	T	17	10	
	"	43		18	23	2
3	"	46		41	5	
	"	60		53	5	2
4	"	26		25	1	
	"	24		20	2	2
Total	S37Ac	177	T	123	54	
	DanAc	214		136	71	7

TABLE 68 - DRY MATTER (x 100 lbs.) PER ACRE - 'C'

INTERRUPTED GROWTH

Period	Plot	Cor. DM/ac	Sown Grass	Other Grass	Other Weeds
1	S37	45	21	24	T
	Dan	50	13	37	
2	"	21	9	12	
	"	21	7	14	
3	"	34	24	7	3
	"	44	30	12	2
4	"	15	12	2	1
	"	16	13	3	T
Total	S37	115	66	45	4
	Dan	131	63	66	2

TABLE 69 - DRY MATTER (x 100 lbs.) PER ACRE - 'C'

UNINTERRUPTED GROWTH

Period	Plot	Cor. DM/ac	Sown Grass	Other Grass	Other Weeds
1	S37	92	63	29	
	Dan	90	32	58	
2	"	32	14	18	
	"	34	15	19	
3	"	42	36	6	
	"	53	33	20	
4	"	15	12	2	1
	"	12	7	5	T
Total	S37	181	125	55	1
	Dan	189	87	102	T

TABLE 70 PERCENTAGE DRY MATTER - COCKSFOOT - 'O' & 'C' - 1959

Period	Management	Plot	Sown Grass	White Clover	Other Grass	Other Weeds	Burn and Soil
3	Grazing 'O'	S37Ac	47.8	0.9	12.4	T	38.9
		DanAc	41.4	2.3	15.7	1.4	39.2
4		"	55.2	1.8	15.6	T	27.4
		"	51.6	1.5	12.1	0.3	34.5
1	No Grazing 'C' Interrupted Growth	"	29.8	5.7	43.5	0.4	20.6
		"	25.7	3.7	50.8	2.0	17.8
2		"	31.7	6.5	47.1		14.7
		"	26.9	3.7	44.7	7.7	17.0
3		"	52.4	4.3	16.4	8.3	18.6
		"	56.0	4.8	13.2	7.1	18.9
4		"	47.5	9.6	14.4	4.6	23.9
		"	53.6	4.7	7.9	13.5	20.3
1	No Grazing 'C' Uninterrupted Growth	"	39.8	T	38.0		22.2
		"	46.2		41.4	1.4	11.0
2		"	58.2	T	32.8		9.0
		"	36.8		50.0	4.1	9.1
3		"	64.2		7.5		28.3
		"	73.2		6.4	3.2	17.2
4		"	81.6		2.1		16.3
		"	73.4		6.7	6.7	13.2
3	Grazing 'O'	S 37	59.5		10.9	0.2	29.4
		Dan	52.4		14.6		33.0
4		"	66.5		6.1		27.4
		"	57.0		11.6		31.4
1	No Grazing 'C' Interrupted Growth	"	42.6		49.0	0.6	7.8
		"	22.5		62.9		14.6
2		"	36.6		51.6		11.8
		"	26.1		56.1		17.8
3		"	47.4		14.5	4.9	33.2
		"	56.6		22.7	3.4	17.3
4		"	64.1		8.2	7.4	20.3
		"	69.5		12.7	1.0	16.8

contd.

TABLE 70 contd.

Period	Management	Plot	Sown Grass	White Clover	Other Grass	Other Weeds	Burn and Soil
1	No Grazing 'C' Uninterrupted Growth	S 37	59.7		28.3		12.0
		Dan	32.0		57.3		10.7
2		"	40.2		52.8		7.0
		"	42.0		51.6		6.4
3		"	58.5		9.9		31.6
		"	49.5		31.2		19.3
4		"	59.5		7.1	4.8	28.6
		"	43.3		32.8	3.0	20.9

The total yield is slightly in favour of the commercial swards but sown grass was about 50 per cent more on the pedigree swards . The commercial was again more weedy. Dry matter percentages for constituents on all treatments are shown in Table 70 above.

On the whole the pedigree grass contributed more to the swards than the commercial . Percentage burn was higher than in 1958 on all plots due to the dry season . There was a greater percentage of weeds under the cutting treatments.

Leaf-stem ratios for all sampling methods and treatments are shown in Table 71 (page 130) with levels of significance. Treatment values for the same period are very similar under grazing and interrupted growing treatments. The commercial and clover swards were very leafy as opposed to the nitrogen swards during period 3 under grazing .

(c) Per cent nitrogen in the herbage

Herbage nitrogen values are shown in Table 72 (page 130).

TABLE 71 - LEAF/STEM RATIO - COCKSFOOT - 1959 - LOG 100_x

Period	Management	Treatment				S.E. of Means of 3
		S37Ac	DanAc	S37	Dan	
3	Grazing	2.3+	2.5+++	2.3	2.4+++	± 0.02
4	'O'	0.3	0.2	0.2	0.3	± 0.31
1	No Grazing	0.3	0.4	0.3	0.3	± 0.09
2	'C'	1.9	2.1	1.9	1.8	± 0.10
3	Interrupted	2.3	2.5	2.4	2.4	± 0.08
4	Growth	0.2	0.4	0.2	0.2	± 0.04
1	No Grazing	2.1	2.1	1.8	2.2	
2	'C'	1.8	1.6	2.0	1.5	
3	Uninterrupted	2.5	2.3	2.1	2.4	
4	Growth	2.3	2.2	2.3	2.3	

\+ 0.05 level significance
+++ 0.001 " "

TABLE 72 - HERBAGE NITROGEN PER CENT - COCKSFOOT - 1959

Period	Management	Plot				S.E. of Means of 3
		S37Ac	S37	DanAc	Dan	
3	Grazing	2.05	2.10	1.85	2.16	± 0.14
4	'O'	1.90	2.17	2.05	2.32	± 0.13
Total		3.95	4.27	3.90	4.48	± 0.24
1	No Grazing	2.40	2.69	2.41	2.60	± 0.13
2	'C'	1.70	1.64	1.62	1.75	± 0.09
3	Interrupted	2.14	2.02	2.12	2.19	± 0.09
4	Growth	2.42	2.11	2.34	2.24	± 0.10
Total		8.66	8.47	8.49	8.78	± 0.30
1	No Grazing	2.39	2.40	2.18	2.31	
2	'C'	1.59	1.52	1.31	1.70	
3	Uninterrupted	2.04	1.89	1.89	2.08	
4	Growth	2.03	1.66	1.65	2.21	

Under grazing the nitrogen swards gave higher values than the clover plots ; the commercial pure grass swards were slightly more leafy than the pedigree. The cutting treatments have not given similar results and values vary probably due to weeds. Uninterrupted growth samples also have a lower nitrogen value than interrupted growth samples reflecting differences in age .

(d) Silage Yields

Mean yields of silage are shown in Table 73 below . There were no significant differences.

TABLE 73 - MEAN YIELDS SILAGE (x 10 lbs.) PER ACRE - COCKSFOOT - 1959

Cut	Treatment				S.E. of Means of 3
	S37Ac	S37	DanAc	Dan	
Spring	729.0	724.0	705.0	794.0	± 32.7

The Danish pure grass swards outyielded all others. Yields on the pedigree swards came next producing about the same in dry matter with clover and nitrogen.

(e) Soil data

Treatment mean carbon and nitrogen values for ryegrass and for cocksfoot plots are given in Tables 74 and 75 respectively (page 132) ; the condition at the beginning and end of the investigation is shown along with actual increments for both species and levels of significance .

TABLE 74 - SOIL CARBON VALUES - MEANS AND STANDARD ERROR

Species	Sampled	Treatment C + N	C + Ac	P + N	P + Ac	S.E. of Means of 3
Ryegrass^{F} + Cocksfoot no^{F}	Spring 1958	3.003	2.775	2.755	2.812	± 0.0956
		2.795	2.647	2.822	2.563	± 0.0116
Ryegrass	Autumn	3.074	2.924	3.228	2.883	± 0.107
Cocksfoot	1959	3.009	2.823	3.011	2.868	± 0.131
Ryegrass	Increase	.087	.177	.276^{++}	.228^{++}	± 0.024
Cocksfoot	1958/9	.198	.150	.207	.149	± 0.060
Ryegrass) Cocksfoot)	"	.143	.163	.242	.188	± 0.037

++ 0.01 level significance
F = Foggage
no F = No Foggage

TABLE 75 - SOIL NITROGEN VALUES - MEANS AND STANDARD ERRORS

Species	Sampled	Treatment C + N	C + Ac	P + N	P + Ac	S.E. of Means of 3
Ryegrass^{F} + Cocksfoot no^{F}	Spring 1958	2.678	2.197	2.545	2.585	± 0.0211
		2.477	2.212	2.480	2.362	± 0.019
Ryegrass	Autumn	.345	.319	.344	.318	± 0.013
Cocksfoot	1959	.335	.312	.317	.317	± 0.015
Ryegrass	Increase	.083	.090	.095	.074	± 0.007
Cocksfoot	1958/9	.082	.099	.063	.067	± 0.012
Ryegrass) Cocksfoot)	"	.082	.095	.079	.071	± 0.006

The increases were neither significant for treatments nor for species although higher incremental carbon values occurred on the ryegrass as against the cocksfoot swards. The varietal increment difference was much in favour of the pedigree ryegrass swards . There was also a slight difference in favour of the pedigree cocksfoot but this was not significant.

The initial nitrogen figures are slightly in favour of the pedigree swards but final values being equal increases were in favour of the commercial swards.

Discussion

As in the previous year, differences between Danish and S37 cocksfoot were small as compared with the greater ones between Irish and S24. On all the clover swards except the uninterrupted cutting treatment the pedigree variety gave greater yields , also on the nitrogen swards under grazing. Under cutting , the increase in weed growth helped to augment dry matter production on the commercial areas.

Although leafiness could be associated with a higher nitrogen value under grazing conditions it could not be the case under cutting. This may have been due to the high percentage of weeds with different leaf-stem proportions and nitrogen values. The higher carbon values may have been due to more decaying herbage on the pedigree swards. The higher nitrogen increase on the commercial plots may have been the result of more quickly decomposed weed growth.

General Discussion

These swards in their third harvest year , during a very dry summer , have shown no remarkable varietal differences from the previous

year. Under grazing conditions , managements of the various treatment swards were more comparable and yields were not very different. The reduction of clover in the clover swards partly accounted for the herbage yields being greater with nitrogen , especially on the pedigree swards. The greater persistence of the pedigree species is also shown during this dry year , with weed grasses showing good tolerance and growth under low soil-moisture conditions. The inconsistency as regards leaf-stem ratios and herbage nitrogen values is believed due to greater weed contamination of swards during the year.

The faecal method of estimating intake seems more reliable than ' before ' and ' after ' grazing samplings during the year. There was a negative relationship between intake and the amount of feed on offer , the quality of herbage and clover proportions being more important. Although there has been little difference between the digestibilities of spring and autumn herbage the live-weight performance of the latter seems to be far inferior. Time of year and age may also have some effect on animal performance .

Increases in soil-carbon over the period of the experiment show highly significant differences in favour of the pedigree ryegrass swards which are probably associated with higher herbage as well as root yields (Garwood , 1959) . The higher values for ryegrass over cocksfoot are similar to results previously obtained at Hurley (Clement , 1958) . Nitrogen -increment values though higher on the commercial / show that the actual soil nitrogen status for comparable treatments is similar.

D. LIVE-WEIGHT DATA

Table 76 (page 135) summarises the weight gains , herbage on offer and quality for each treatment at each stage during the year.

TABLE 76 LIVE-WEIGHT INCREASE , DRY MATTER/ac. AND PER CENT NITROGEN - 1959

TREATMENT	TREATMENT TOTALS 1959			PERIODS											
				1 9.4. - 21.5			2 4.6. - 18. 6.			3 18.6. - 9. 9.			4 10.9. - 5. 11		
	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N	L.W.I. per ac.(lb)	100 lb. D.M./ ac.	% N
1: C+N	(2) 283.99	(2) 85.33	(2) 9.53	(1) 113.33	(1) 11.56	(4) 3.17	(2) 59.11	(2) 8.00	(2) 1.94	(3) 100.44	(2) 45.33	(2) 2.14	(3) 11.11	(4) 20.44	(1) 2.28
2: C+Ac	(3) 278.67	(4) 83.56	(1) 9.56	(2) 104.89	(2) 11.11	(2) 3.20	(1) 60.00	(3) 7.56	(1) 1.97	(1) 103.11	(4) 42.22	(1) 2.24	(4) 10.67	(3) 22.67	(2) 2.15
3: P+N.	(1) 285.33	(1) 99.57	(3) 9.45	(3) 101.33	(3) 10.67	(1) 3.31	(3) 58.67	(1) 10.67	(3) 1.93	(2) 101.33	(1) 51.56	(3) 2.06	(1) 24.00	(1) 26.67	(2) 2.15
4: P+Ac	(4) 253.55	(3) 84.45	(4) 8.91	(4) 97.33	(4) 10.22	(3) 3.18	(4) 39.33	(4) 7.11	(4) 1.90	(2) 101.33	(3) 43.56	(4) 1.95	(2) 15.56	(2) 23.56	(3) 1.88
TOTAL	1101.54	352.91		416.88	43.56		217.11	33.34		406.21	182.67		61.34	93.34	

As in the previous year live-weight increase was influenced by herbage quality ; and in this year , by the amount of herbage as well,since the quality at each stage on all swards was not very different.

Grazing was closer than in the previous year . The pure grass swards produced more dry matter per acre than the clover swards , which had very low clover contents . Although response to artificial fertiliser was low due to insufficient rainfall during the year , these swards seemed to have responded more quickly to small showers than did the clover swards.

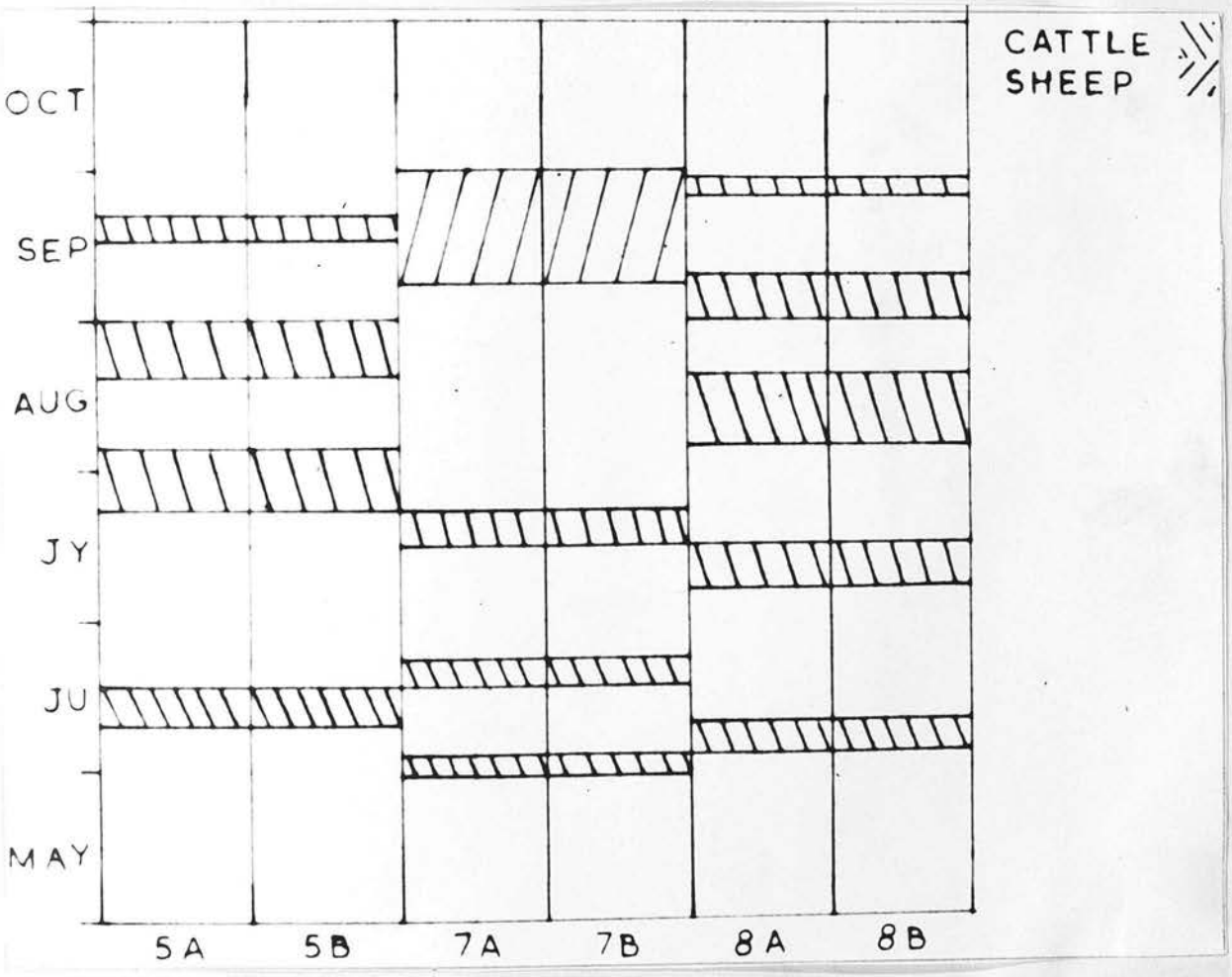
111. EXPERIMENT 14. CHAPEL FIELD 1 AND 11 - H 15

The 2 periods are as follows :-

Period	3	June	16	- August	19	Summer Growth
"	4	August	20	- September	24	Autumn "

The period of grazing was very short due to dry conditions , weeds also prevented proper establishment. Utilisation is shown in Figure 24.

FIGURE 24 HERBAGE UTILISATION



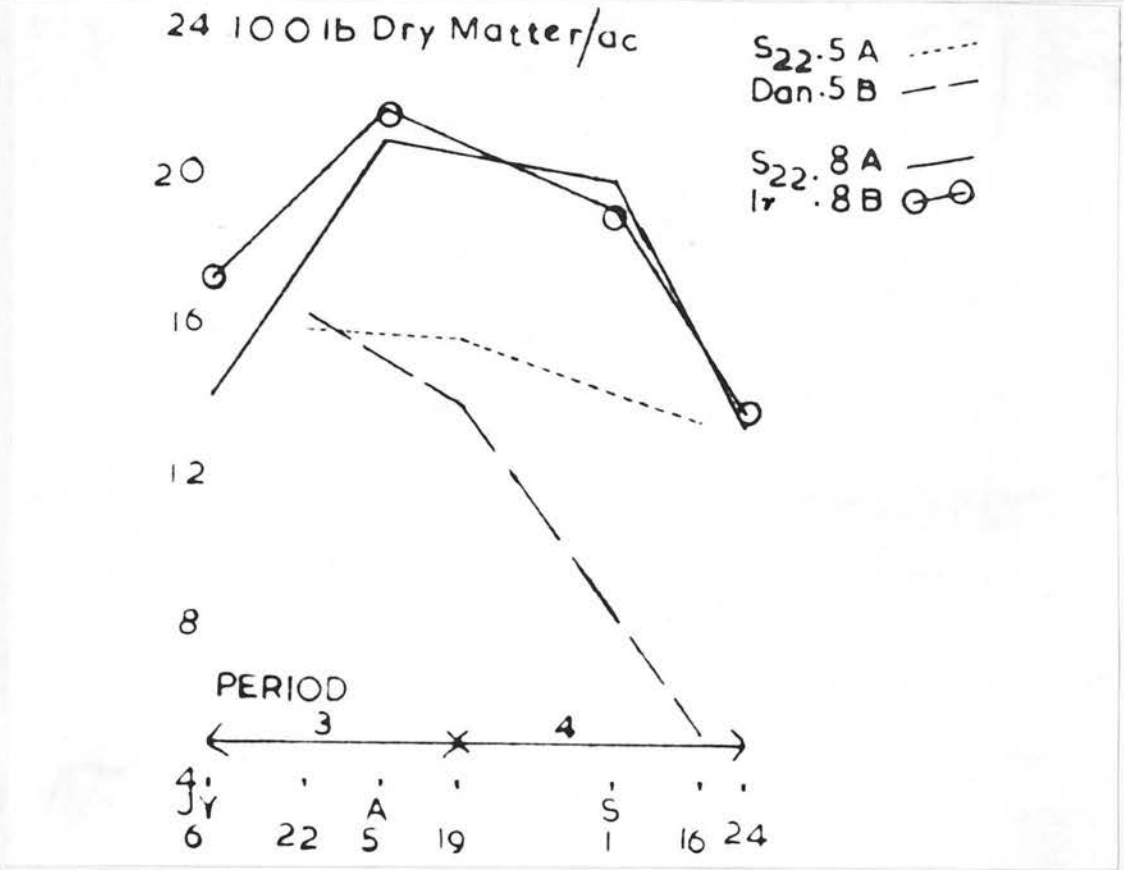


TABLE 77 DRY MATTER YIELDS (x 100 lbs.) PER ACRE - '0'

Period	Sown	Plot	Cor D.M/ac	Sown Grass	Other Grass	Other Weeds
3	Spring 1959	5A	31	6		25
		5B	30	5		25
		8A	35	8		27
		8B	40	5		35
4		5A	14	1		13
		5B	4	1	T	3
		8A	34	6		28
		8B	33	6		27
Total		5A	45	7		38
		5B	34	6	T	28
		8A	69	14		55
		8B	73	11		62

A. Italian Ryegrass - Plots 5 and 8

(a) Herbage Yields

(1) Under Grazing - ' O '

Dry matter of green herbage on offer is shown in Figure 25 and Table 77 opposite . The differences between S22 and Irish (plot 8) were smaller than those between S22 and Danish commercial on plot 5 ; Irish commercial produced more in period 3. Percentage contribution of the various constituents is shown in Table 78.

TABLE 78 - PERCENTAGE DRY MATTER - ' O '

Period	Plot	Leaf	Stem	Sown Grass	Other Grass	Other Weeds	Burn & Soil
3	5A	13.7	3.1	16.8		66.9	16.3
	5B	13.8	3.2	17.0		79.4	3.6
	8A	16.9	4.0	20.9		69.4	9.7
	8B	7.4	2.8	10.2		79.6	10.2
4	5A	4.0	1.8	5.8		85.6	8.6
	5B	8.8	6.1	14.9	0.9	37.7	46.5
	8A	7.6	5.1	12.7		65.6	21.6
	8B	7.8	4.5	12.3		63.9	23.8

Although weeds contributed largely to the dry matter production , establishment on the pedigree sward earlier in the season was much better on plot 8 , and about the same on plot 5 , as the corresponding commercial. Burn was largely confined to topped weeds .

(2) Under Cages - ' C ' - Plots 5 and 8

Yields are shown in Figure 26 (page 140) and Table 79 (page 141) for both interrupted and uninterrupted growth.

FIGURE 26 - DRY MATTER (x 100 lbs.) PER ACRE - 'C'

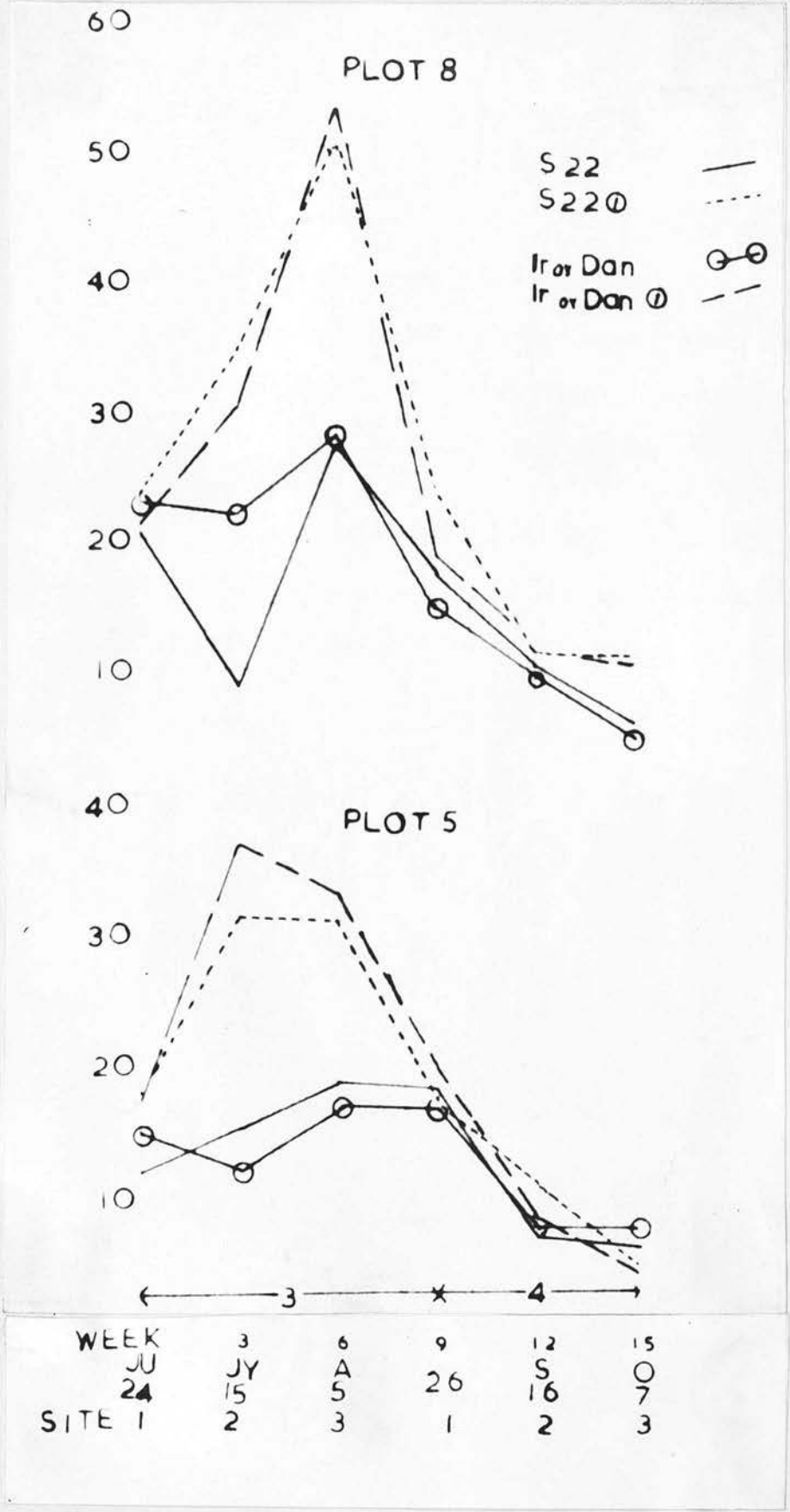


TABLE 79 - DRY MATTER YIELDS (x 100 lbs.) PER ACRE - 'C'

Period	Sown	Plot	Cor. DM/ac	Sown Grass	Other Grass	Other Weeds
3	Spring '59	5A	63	27	5	31
		5B	59	27	T	32
		5A(1)	97	32		65
		5B(1)	106	33	1	72
		8A	73	31		42
		8B	87	23		64
		8A(1)	131	27		104
		8B(1)	123	25	T	98
4		5A	13	4	T	9
		5B	15	8		7
		5A(1)	15	5	T	10
		5B(1)	12	6	1	5
		8A	16	2		14
		8B	14	1		13
		8A(1)	22	8	T	14
		8B(1)	21	4	T	17
		5A	76	31	5	40
		5B	74	35	T	39
		5A(1)	112	37	T	75
		5B(1)	118	39	2	77
Total		8A	89	33	T	56
		8B	101	24		77
		8A(1)	153	35	T	118
		8B(1)	144	29	T	115

The total production was about 50 per cent greater where no topping occurred ; and the yield of the Danish was very similar to the S22 on plot 5. On plot 8 , although total yields were more on the commercial swards , sown grass on the S22 areas was greater . The less severe treatment seemed to have retarded growth especially of the Irish later in the season. Dry matter percentage is shown in Table 80 (page 142).

TABLE 80 - PERCENTAGE DRY MATTER - 'C'

Period	Plot	Leaf	Stem	Sown Grass	Other Grass	Other Weeds	Burn & Soil
3	5A	29.3	10.7	40.0	8.0	46.7	5.3
	5B	32.7	11.5	44.2	T	52.0	3.8
	5A(1)	23.0	8.0	31.0		63.3	5.7
	5B(1)	22.6	7.5	30.1	1.1	65.6	3.2
	8A	28.8	11.6	40.2		53.8	5.8
	8B	14.5	9.7	24.2		66.1	9.7
	8A(1)	13.8	6.2	20.0		75.4	4.6
	8B(1)	13.5	5.7	19.2	T	76.0	4.8
4	5A	12.6	6.3	18.9	0.9	41.5	38.7
	5B	23.1	9.6	32.7		28.8	38.5
	5A(1)	20.3	7.2	27.5	T	52.2	20.3
	5B(1)	23.8	10.9	34.7	3.0	29.6	32.7
	8A	4.1	2.1	6.2	2.1	64.9	26.8
	8B	4.7	1.9	6.6		62.9	30.5
	8A(1)	19.4	9.7	29.1	T	50.3	20.6
	8B(1)	8.5	5.0	13.5	1.7	53.4	31.4

Sown grass contributions of comparable varieties under both cutting treatments are fairly similar ; greater weed growth in the Irish reduced its contribution in period 4.

(b) Percentage nitrogen of herbage

Herbage nitrogen values are shown in Table 81 (page 143) for each period under grazing and cutting managements. On plot 8 the values seem consistently greater on the commercial plots : the opposite was found on plot 5 . This may be a reflection of the soil condition (which is indicated in Table 82 , page 143) or of greater weed growth. Uninterrupted growth values are not always lower than the swards which

were topped and this may be due to the fact that the removal of the softer material at topping left the stemmier material.

TABLE 81 - PERCENTAGE NITROGEN - HERBAGE DRY MATTER - '0' and 'C'

Period	Treatment	Plot							
		5A	5B	5A(1)	5B(1)	8A	8B	8A(1)	8B(1)
3	Grazing '0'	2.53	2.37			3.07	3.10		
4		2.18	2.21			2.15	2.16		
3	No Grazing 'C' Interrupted Growth	3.16	2.42			2.46	2.46		
4		2.76	2.70			2.44	2.54		
3	No Grazing 'C' Uninterrupted Growth			3.28	1.84			2.37	2.53
4				2.61	2.52			1.99	2.22

(c) Soil Data

Values for determination at the beginning and end of the year are shown in Table 82.

TABLE 82 - PER CENT SOIL CARBON AND NITROGEN

Plot	% Carbon				% Nitrogen			
			Increase				Increase	
	Spring	Autumn	Amt.	%	Spring	Autumn	Amt.	%
5A	1.929	2.120	0.191	9.9	.249	.251	.002	0.8
5B	2.014	2.124	0.11	5.5	.248	.264	.016	6.5
8A	1.676	1.853	0.177	10.6	.206	.215	.009	4.4
8B	1.673	2.030	0.357	21.7	.223	.233	.010	4.5

There is no varietal pattern in the increase in the carbon values, which seem to be influenced more by local conditions, weed growth and burnt material, largely broad leaved weeds, which were greater on plots 5 A and 8 B. The nitrogen value showed an increase in favour of the commercial

sward on plot 5 especially. The figures fall within the range associated with such determinations.

(d) Live-weight data

Live-weight increase measured from each plot is shown in Table 83.

TABLE 83 - LIVE-WEIGHT INCREASE, ANIMAL AND HERBAGE STARCH EQUIVALENT (x 100 lbs.) - 1959

Plot	Herbage on Offer (x 100 lbs.)		L.W. Gain lbs.	Live-weight (x 100 lbs.)
	D.M.	S.E.	Calves	S.E.
5A	77.05	809	524	16
5B	58.44	611	303	13
8A	123.30	1327	495	16
8B	131.05	1431	696	19

The production starch equivalent reflects, in both cases, the amount of feed on offer, which favoured the pedigree on plot 5 and the commercial on plot 8. From both plots the output from pedigree and commercial swards is identical.

(e) Discussion

A good germination was followed by dry conditions throughout the summer and favoured weed growth at the expense of the sown grass; under these conditions there was a slightly better pedigree coverage at first but later in the season the difference decreased. Under cutting Danish was established later than Irish. Herbage nitrogen values were largely influenced by weed growth and reflected fertility status of each plot.

FIGURE 27 DRY MATTER (x 100 lbs.) PER ACRE '0'

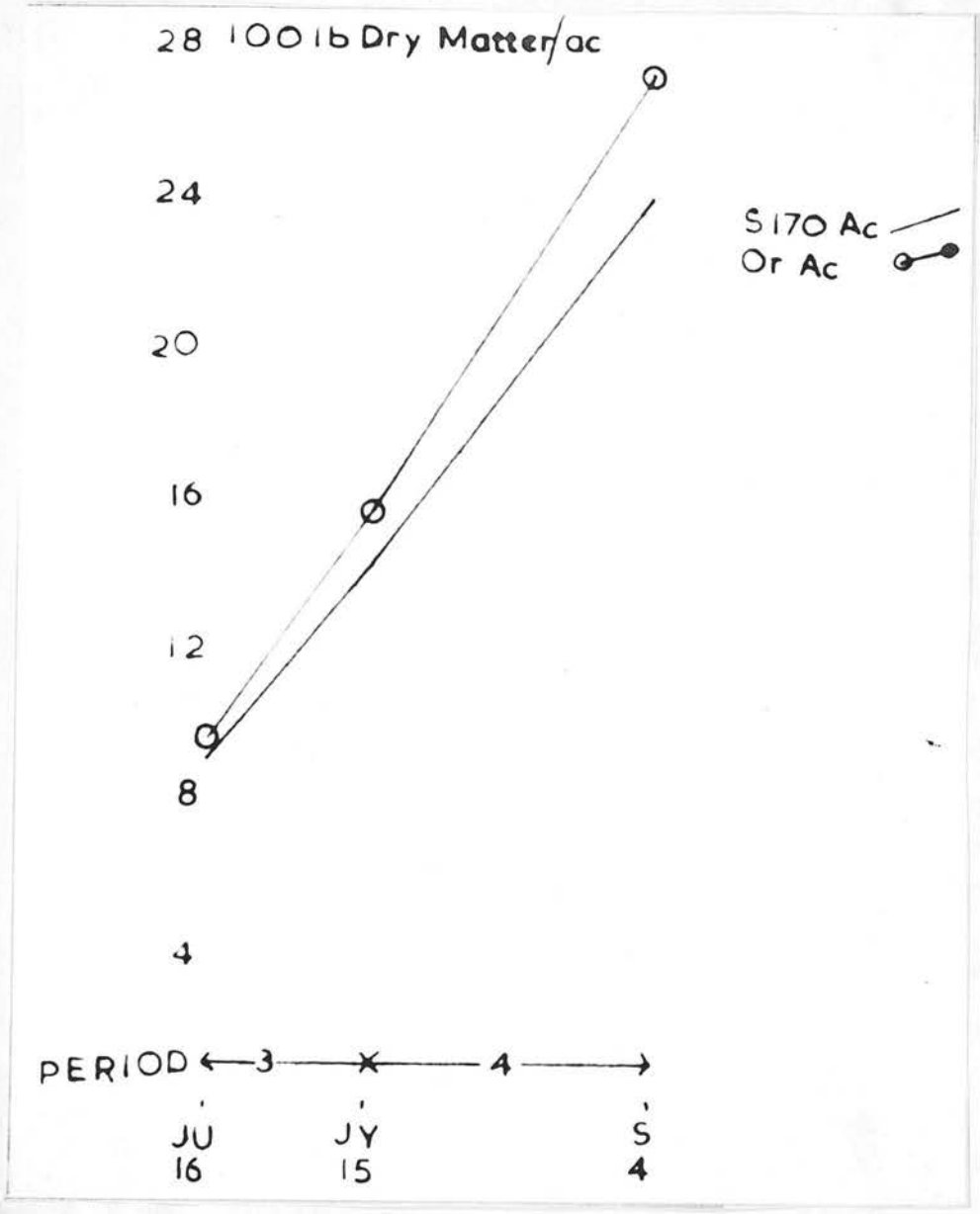


TABLE 84 DRY MATTER (x 100 lbs.) PER ACRE '0'

Period	Sown	Plot	Cor D.M/ac	White Clover	Sown Grass	Other Grass	Other Weeds
3	Spring 1959	7A	23	T	1	T	22
		7B	25	T	T	1	24
4		7A	24	1	2	2	19
		7B	27	1	4	1	21
Total		7A	47	1	3	2	41
		7B	52	1	4	2	45

No definite pattern emerged from the soil study , but it would appear that weed growth may have been a contributing factor to increasing values. The similarity in starch equivalent output (Table 83) and the comparable nitrogen status of the sward (Table 81) seem to indicate that various stocking rates could pick up differences observed in clipping.

B. Tall Fescue - clover

(a) Herbage Yields

(1) Under Grazing - '0'

Yield of dry matter per acre on offer is shown graphically in Figure 27 and in Table 84 opposite.

Establishment was very slow due partly to insufficient rain and profuse weed growth. Contribution of the various constituents is shown in Table 85 .

TABLE 85 - PERCENTAGE DRY MATTER - ' 0'

Period	Plot	Leaf	Stem	Sown Grass	White Clover	Other Grass	Other Weeds	Burn & Soil
3	7A	1.0	0.6	1.6	T	1.0	95.5	1.9
	7B	0.8	0.3	1.1	0.3	3.3	94.7	0.6
4	7A	4.7	2.0	6.7	6.0	6.7	78.0	2.6
	7B	8.9	2.6	11.5	4.8	5.3	76.3	2.1

The commercial sward seem to have been better established. Clover establishment was equal throughout .

(2) Under Cages 'C'

Yields of herbage dry matter at each sampling are shown in Figure 28 and for each period in Table 86 on the next page.

FIGURE 28 DRY MATTER (x 100 lbs.) PER ACRE -'C' UNINTERRUPTED GROWTH

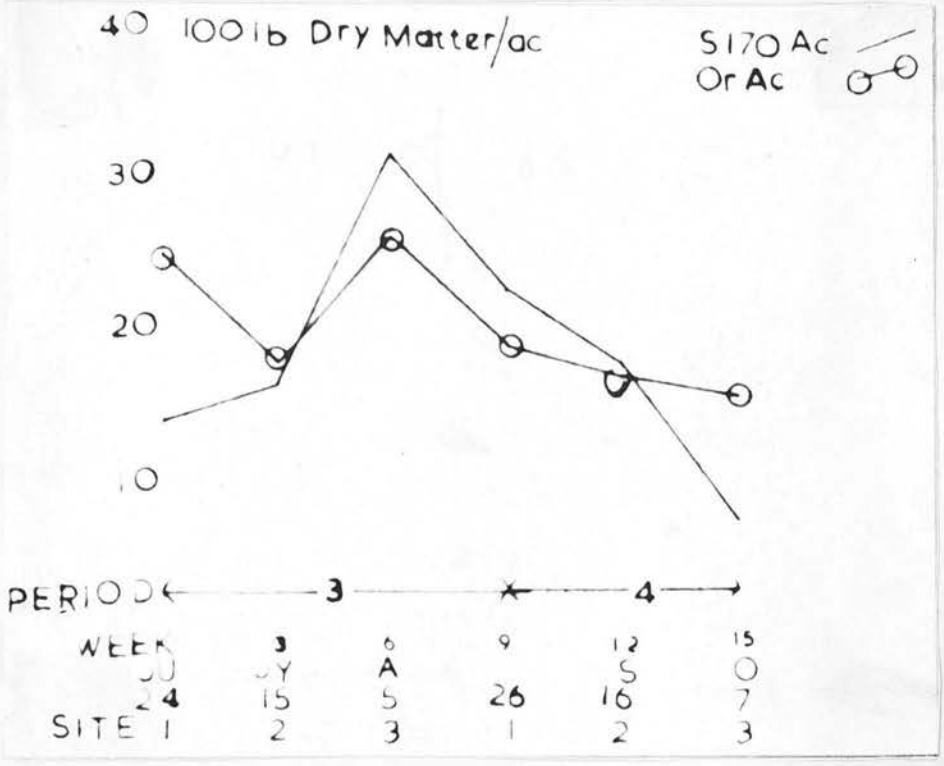


TABLE 86 DRY MATTER (x 100 lbs.) PER ACRE - 'C' UNINTERRUPTED GROWTH

Period	Sown	Plot	Cor D.M/ac	White Clover	Sown Grass	Other Grass	Other Weeds
3	Spring 1959	7A	83	10	3	6	64
		7B	86	3	2	1	80
4		7A	24	10	4	1	9
		7B	32	8	2	1	21
Total		7A	107	20	7	7	73
		7B	118	11	4	2	101

There was more clover on the pedigree sward and fewer weeds (Table 87) . The commercial plot had almost 40 per cent more broad leaved weeds than the pedigree.

TABLE 87 - PERCENTAGE DRY MATTER - ' C '

Period	Plot	Leaf	Stem	Sown Grass	White Clover	Other Grass	Other Weeds	Burn & Soil
3	7A	2.0	1.0	3.0	11.9	7.9	76.2	1.0
	7B	1.4	0.5	1.9	3.9	1.4	90.9	1.9
4	7A	11.1	2.8	13.9	30.6	2.7	27.8	25.0
	7B	4.2	1.3	5.5	22.7	1.6	60.5	9.7

The pedigree species throughout contributed more to the sward owing to lower weed growth than the commercial.

(b) Percentage nitrogen of herbage

Herbage nitrogen values for each period are shown in Table 88.

TABLE 88 - PERCENTAGE NITROGEN - HERBAGE DRY MATTER - '0' and 'C'

Period	' 0 '		' C '	
	7A	7B	7A	7B
3	2.25	2.59	2.46	2.28
4	2.24	2.29	2.70	2.08

The commercial swards were of a higher quality under grazing ; the position was reversed under cutting and may have been due to the greater clover content in the pedigree swards.

(c) Soil data

Values for soil carbon and nitrogen are shown in Table 89.

TABLE 89 - PER CENT SOIL CARBON AND NITROGEN - 1959

Plot	% C				% N			
	March '59	Nov. '59	Increase Amt.	Increase %	March '59	Nov. '59	Increase Amt.	Increase %
7A	2.201	2.228	0.027	1.2	0.264	0.271	.007	2.7
7B	2.246	2.574	0.328	14.6	0.265	0.235	-.03	-13.0

The carbon results are reasonable and the nitrogen ones are low and could be due to error inherent in the method.

(d) Live-weight data

The total live-weight increase from these plots reflected in pounds and in starch equivalent values is shown in Table 90 together with herbage starch equivalent on offer .

TABLE 90 - LIVE-WEIGHT INCREASE , ANIMAL AND HERBAGE STARCH EQUIVALENT (x 100 lbs.) - 1959

Plot	Herbage on Offer (x 100 lbs.)		L.W.Gain (lb)		L.W. - S.E. (x 100 lbs.)
	D.M.	S.E.	Calves	Sheep	S.E.
7A	86.38	497	231	189	25
7B	96.80	583	224	356	30

The greater animal output from the commercial was as much due to greater initial live weight of these animals as to there being more herbage of a higher quality on offer. It is of interest to note that the same amount of available herbage on both swards produced the same unit

of animal starch equivalent.

(e) Discussion

Excessive weed growth and very dry conditions during the year tended to suppress sown species. Weeds contributed much of the total dry matter produced. The grass component of the commercial area was better established under grazing , and there was more clover on the pedigree sward. In the cutting treatments the plots were topped once to control weeds and none of the sown sward was removed.

Chemical status of both herbage and soil reflects a greater potential of the commercial sward.

General Discussion

Under the dry conditions prevailing during the year , the Irish Italian ryegrass was more productive than the S22 which was better than Danish. Under cutting there was nothing to choose between S22 and Danish. The commercial tall-fescue sward produced more dry matter than the pedigree. Both Irish Italian ryegrass and Oregon certified tall fescue seemed to have been adversely affected by the cutting treatment.

There is some indication that , when offered herbage of a given quality , live-weight production in the cattle beast is more influenced , than that of sheep , by the quantity of food available. The slow establishment of tall fescue suggests that such swards would well be established under a nurse cereal or preferably a legume crop such as red clover , the cover crop being removed before it can damage the sward.

6. A STUDY OF DIFFERENT HEIGHTS OF CUTTING

Object

The aim of this investigation was to compare the effects of cutting to ground level using the sheep shear with cutting to 1 inch with a Tarpen Trimmer. Differences in recovery could be anticipated and it would then be possible to translate yields similarly obtained on the caged areas.

Material

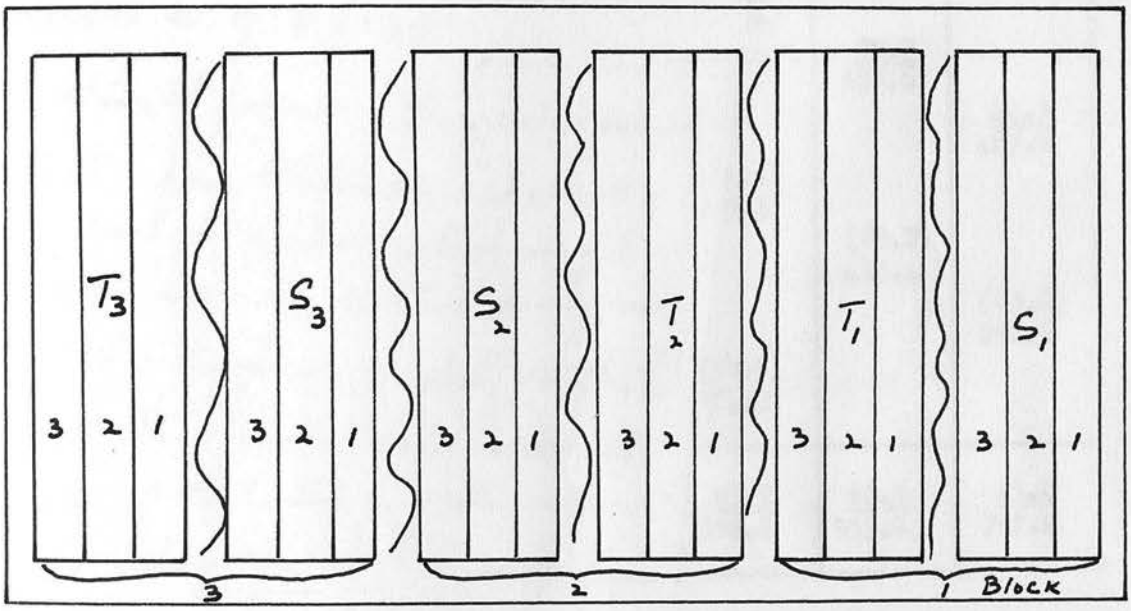
A (6 x 1) foot quadrat was used to define the area cut by the sheep shear and a similar area was cut with a 1 foot wide Tarpen Trimmer using a straight edge 6 foot long. A predominantly perennial ryegrass-clover sward was used. After a single grazing the area was shut up from early spring 1959. Both cutting tools were operated off a Tarpen generator as per Figure 29 below with a suitable clutch mechanism for the shear head.

FIGURE 29 - TARPEN GENERATOR WITH TRIMMER AND SHEEP SHEAR

Method

A similar sampling technique to that used on caged sites was adopted using 3 adjacent sampling areas. Sampling was done at 3-weekly intervals and each site was sampled every 9 weeks. Three samples were taken with each cutter on each sampling date. Plan of the site is shown in Figure 30 below.

FIGURE 30 - PLAN OF SAMPLE AREA



S = Sheep Shear

T = Tarpen Trimmer

N

As much soil as possible was removed from each sample after cutting. The entire green herbage from each cut was weighed then dried. The dried residue was weighed for dry matter estimation. After grinding, all three replicate samples were bulked for ash determination to correct for organic matter production.

Results

Table 91 (page 153) gives results from the 7 sets of samples taken during the year . The severe drought prevented recovery and sampling after

mid-October was impossible. The areas cut with the shear were more affected at the end of the season (Jantii et al., 1957) .

TABLE 91 - ORGANIC MATTER PRODUCTION (GRAMS)

Sample Date	Tarpen			Sheep Shear		
	Site			Site		
	1	2	3	1	2	3
10.6.59	218.8			74.8 381.5		
1.7.-		307.4			70.3 523.6	
22.7.-			314.2			48.9 467.8
	(83.9)			(81.1)		
12.8.-	183.5			309.3		
		(92.5)			(83.2)	
2.9.-		284.3			435.4	
			(72.1)			(63.0)
23.9.-			226.5			294.6
	(68.9)			(32.5)		
14.10.-	150.7			124.0		
Total	553.0	591.7	540.7	47.3 814.8	62.1 959.0	41.0 762.4

Figures in brackets (Table 91 above) indicate percentage recoveries of the initial yield on respective sites , while the shear figures underlined show percentage increases on the comparable Tarpen yields. The smaller difference shown for the third site at the first cut (48.9 - 74.8) was due to death of tillers and of herbage due to shading ; this was anticipated. Indications form results reported elsewhere (page 158) show that a high percentage of the total yield of such swards is to be found in the lowest 1 inch when death of tillers and lower growth did not occur. This point will be discussed later.

Although the percentage recovery was greater (as would be expected),

in the case of the less severe cutting treatment with the Tarpen trimmer , organic matter production (and dry matter too) was greater with the sheep shear . As the Tarpen initially removed less herbage this could be responsible , to some extent , for the higher recovery with this latter trimmer . The results are similar to those reported by the Grassland Research Institute , Hurley (1957/8) and Reid (1959) for similar different heights of cutting experiments.

Though herbage nitrogen values were nearly always higher on Tarpen samples , the total weight of nitrogen recovered was always greater with shear samples (Table 92 below). The difference in favour of the latter was 43 per cent over the period.

TABLE 92 - HERBAGE NITROGEN PER CENT AND RECOVERIES

Sample Date	Tarpen		Sheep Shear	
	% N	Wt. N (Grms.)	% N	Wt. N (Grms.)
10.6.59	2.72	5.95	2.60	9.92
1.7.-	2.12	6.52	2.04	10.68
22.7.-	2.18	6.85	2.21	10.34
12.8.-	2.52	4.62	2.47	7.64
2.9.-	2.70	7.68	2.53	11.02
23.9.-	2.58	5.84	2.21	6.51
14.10.-	2.55	3.84	2.50	3.10
Total		41.30		59.21
% Increase				43.4

Discussion

Although the data presented are not wholly adequate, certain principles seem to emerge. Brougham (1956), over relatively short periods of 32 days, showed that the most severe cutting gave the least yield of dry matter. The results here show that with a 9-week recovery period yields on the lower cutting treatment were higher always since this allowed sufficient rest and recovery for both swards to make maximum growth at their respective heights after attaining similar leaf coverage. Results reported elsewhere (page 158) show that herbage below 1 inch cutting height can account for, on average, 30 per cent of the total organic matter yield if measured from ground level. Initial differences in production are, therefore, determined by the different heights of cutting.

This initial treatment will thus influence further sward development. The ground level sampling seems to stimulate greater tillering (also shown by Brougham, 1957 and by work done at the Grassland Research Institute, Hurley, 1957/8) thus providing a larger quantity and (relatively) more actively growing material than when cutting is done with the Tarpen. These actively growing areas are more quickly exposed to light energy and so gain an advantage over similarly positioned growing sites on the less severe treatment. Under suitable growing conditions (i.e. adequate soil moisture and fertility with ample light and sufficiently high temperatures) and allowing for a suitable rest period between consecutive cuttings the lower cut will produce more herbage.

By cutting higher with the Tarpen, the residue of herbage continually left behind is older material, apparently not growing so actively and possibly less efficient in converting light energy. Part of the food reserves of the plant is thus used to maintain these residues rather than to

make new growth all of which apparently comes from below ground level (i.e. from the root mass) . Where the height of these residues increasesup to 4 or 6 inches it can be seen that they may well be an embarrassment to the plant and certainly represent a " weak " zone in the sward and in the growth rhythm .

Conclusions

The conclusions which can be drawn from these observations are as follows :-

Different cutting heights of the same sward will always give the highest initial yield where sampling is lowest.

The degree of difference in subsequent recovery yields will be determined largely by the period between consecutive samplings of the same site and the proportion of " bottom " in the sward , either of grass or clover.

The above condition assumes an environment for adequate growth. Too long an interval between cutting increases the dying-out of the lower growth and reduces the differences , while too short an interval or dry conditions will give the opposite results.

When conditions for growth are adequate the differences in recoveries between Tarpen and shear may not tend to widen as sharply as the figures show from late September on. Theoretically at least , it would appear that removal of herbage at the opportune stage of growth would produce highly productive swards for a long time , conditions being suitable. The lower the cutting the greater would be the returns. Complete removal of herbage is undesirable since under practical conditions there may not be that stimulus to growth due to some limiting factor , for example , light , temperature or water.

The average increase for the year of 50 per cent may be the measure of the relationship between both methods of sampling under cages. That is to say that the yields from the sheep shear may have been 50 per cent greater than those expected from Tarpen samples.

A STUDY OF THE SAMPLING METHOD

Object

The intention of this study was to measure the soil contamination likely to be encountered with this sampling technique and also to compare its efficiency with more standard methods.

Material

A basic (6 x 1) foot sample area was chosen for comparison using a Tarpen trimmer and sheep shears. The latter was used both when the area was defined by means of a frame and also without ; 4 strips (6' x 3 ") being used in this latter instance. A smaller quadrat (3 x 2 4/5) inch was used once for comparison.

Method

Adjacent sets of 20 samples were taken in the spring and summer. In the autumn when a comparison was made between a 6' x 3" and (6 x 1) foot area , after defining the area with a quadrat a strip (6' x 3") was first taken from each area. The remainder of the area was then cut and both samples used as the quadrat yield. When the (3 x 2 4/5) inch quadrat was used two samples were collected , cut by a pair of scissors to ground level , and bulked for comparison with each (6 x 1) foot sample.

Samples were treated as on previous occasions and organic matter production estimated . Each four of the appropriate (6' x 3") strips were bulked for analysis. The swards used consisted mainly of perennial ryegrass-clover.

Results

A preliminary check on the ash content and variability of 31 samples (6' x 3") and (1 x 1) foot cut with a shear showed no significant differences (Richards , 1959) ; details are given in Appendix 2 . Full details of all samples reaped with ash values are given in Table 93 below.

TABLE 93 - PARTICULARS OF ORGANIC MATTER PRODUCTION (GRAMS.)

	Quadrat (6 x 1) ft	Tarpen (6 x 1) ft	Tarpen Residue (6 x 1) ft	Sheep Shear 4(6'x3")
	Spring			
No. Samples	20	20	20	20
Mean Wt. (O.M.)	147.99	111.97	35.65	122.84
% Ash	16.9	12.5	26.2	14.5
% N	2.238	2.709	2.06	2.345
Ratio (O.M.)	100	75.7	24.3	83.1
S.E. of Mean	6.858	5.288		6.548
S.E. of Indiv.	30.67	23.65		29.28
C.V.	20.7	21.1		23.8
	Summer		Quadrat 2(3" x 2 4/5)	
No. Samples	20	20	17	20
Mean Wt. (O.M.)	185.34	95.60	6.86	140.16
% Ash	19.205	10.77	28.6	14.4
% N	2.062	2.476	1.8	2.156
Ratio (O.M.)	100	51.6	190.4	75.6
S.E. of Mean	11.5	6.61	0.643	10.2
S.E. of Indiv.	51.3	29.6	2.65	45.6
C.V.	27.7	30.9	37.9	32.5
	Autumn		Should this be 3.1.	
No. Samples	100			100
Mean Wt. (O.M.)	123.55			21.32
% Ash	18.81			17.98
Ration (O.M.)	100			16.4
S.E.of Mean	3.966			0.850
S.E. of Indiv.	39.66			8.499
C.V.	32.1			39.9

Both in the spring and summer the (6 x 1) foot quadrat yields were highest with strips (6' x 3") and Tarpen yields in that order next. The Tarpen residue cuts with the sheep shear gave over 33 per cent of the yield of these sites and 25 per cent of that from the quadrat areas. Coincidentally both Tarpen + residue yields and quadrat yields in the spring were identical. The high overestimation of the smaller quadrat is due largely to the poor definition of edges especially on the clovery portions of the sward ; and possibly too due to the fact that with the soil crumbling away it was not always easy to define the portions below soil surface.

Discussion

Ash and nitrogen values fall in with expectation although in the case of the smaller quadrat ash and nitrogen values are unexpectedly high and low respectively. Part of the high values with the smaller quadrat is probably due to sampling portions of the sward below ground level. The coefficient of variation of the various methods again are not significantly different apart from the smaller quadrat ; the high variation could be attributed to the error of small sampling units. A greater number especially for bulking would help to overcome this since material was not available for some of the chemical determinations.

There was the tendency for the variability of the 6' x 3" samples to be slightly greater and this could be due to the fact that by pairing and bulking the full range of greater efficiency could not be exploited. With this modification for further comparisons it is felt that these samples could be more economical and permit of a comparison of smaller differences.

The lower yield estimated by the 4 strips as compared with the quadrat (6 x 1 foot) both in summer and autumn is assumed to be due

largely to incomplete removal of all available herbage. With the quadrat it is possible to sample the area cleanly by going over the spot more than once. This is not possible with the strips . The higher variability could be due to differences in degree of completeness of sampling.

DISCUSSION OF ENTIRE RESULTS

The herbage yields of four species of grasses have been measured over two years to compare commercial and pedigree varieties of each , some with and/without some white clover . Animal live-weight gains were also obtained using ewe lambs and steers. The results have been conditioned by a very wet year when herbage yields on the various treatments were very different for much of the year and a very dry year when yields were very similar , clover was suppressed and inorganic fertiliser response was small. It therefore seems most suitable to consider the results for each year separately rather than together.

EXPERIMENT 1

During the very wet year of 1958 on those swards in their second harvest year , the sown grass populations on the cocksfoot plots were very similar , although clover content was higher on the commercial swards under all managements. This was also observed by Green (1948) and Jones (1932). On the perennial ryegrass swards the Irish commercial plots had a much lower population of sown grass than the S24. As the Irish died out, unsown grass and broad leaved species invaded the pure grass swards and the clover content of the grass-clover plots also increased. This resulted in a greater population of clover than there was on the corresponding S24 areas. These ryegrass-clover plots also had much more clover than their equivalent cocksfoot swards. The cutting treatment by reducing grass competition , especially the commercial grasses , also increased clover proportions on the sample sites.

The Irish commercial was much less persistent than the S24 pedigree perennial ryegrass and the lower spring yields on these commercial swards might have resulted from this factor. Persistence was similar in the case

FIGURE 30 - LIVE-WEIGHT INCREASE AND PERCENTAGE NITROGEN -

HERBAGE ON OFFER/ 14 DAYS

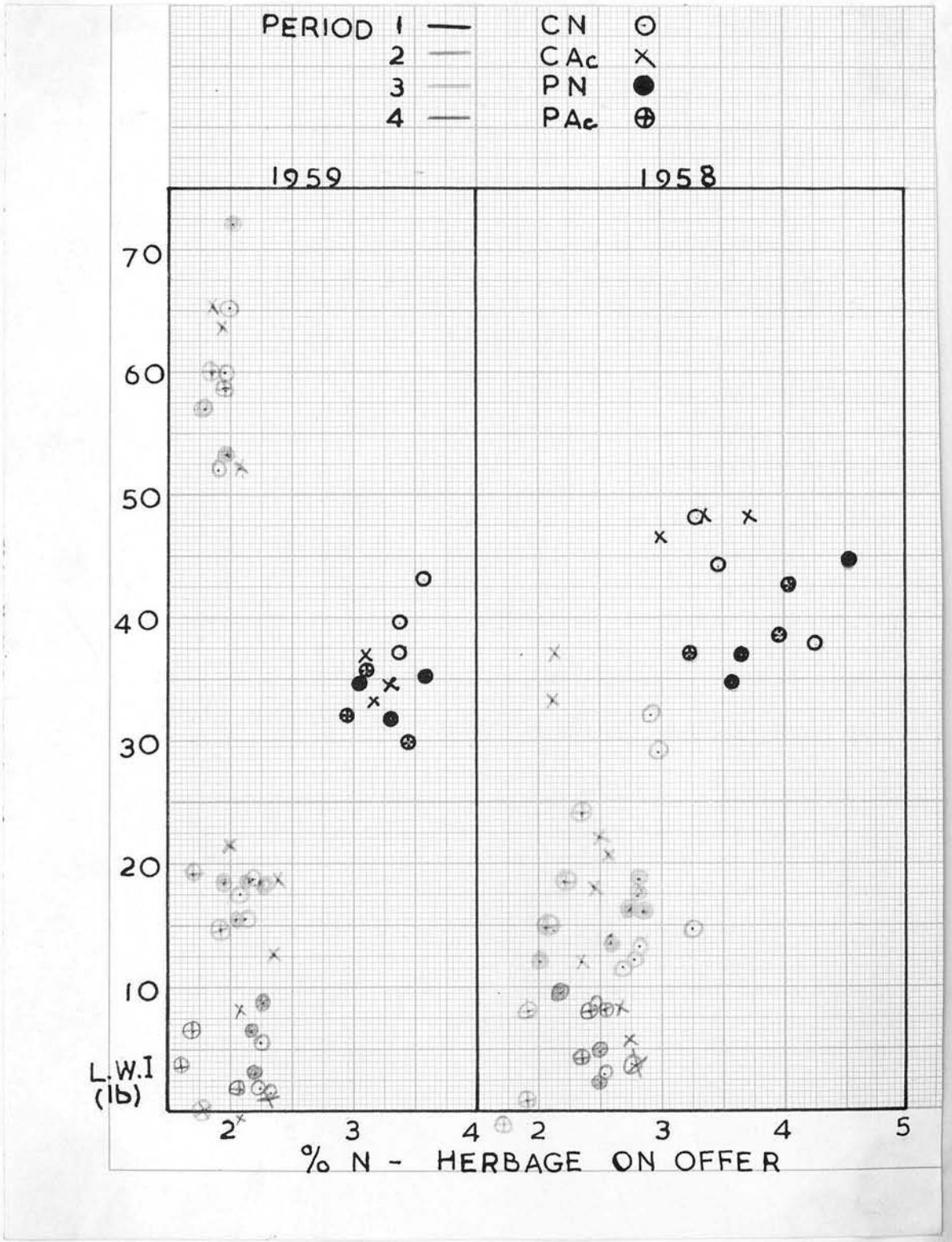
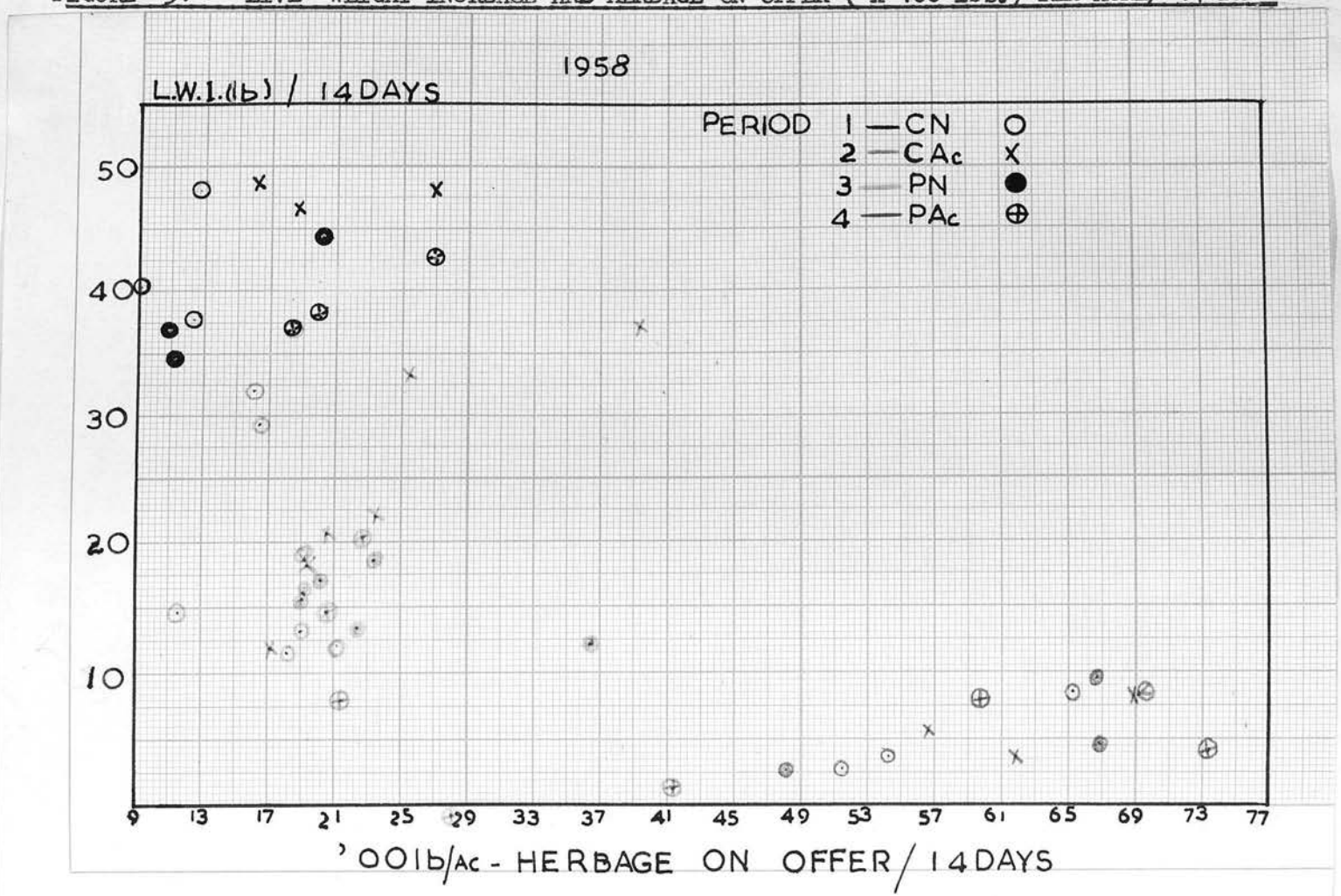


FIGURE 31 - LIVE-WEIGHT INCREASE AND HERBAGE ON OFFER (x 100 lbs.) PER ACRE/ 14 DAYS



of both cocksfoot varieties , and spring yields were higher on the Danish commercial swards. This difference in persistence may also have affected the response of these swards to fertiliser application as there was always more mature herbage on the pedigree ryegrass swards under grazing conditions after spring. Attempts to equate artificial nitrogen to clover nitrogen were not very successful as is shown by the differences in herbage quality on grass-clover and pure grass swards during the year. Even when these swards are of equal nitrogen content it is questionable as to whether they will produce similar live-weight increases from equal amounts of intake. The indications from intake work undertaken during the year are that more of the clover swards will be consumed, thus resulting in greater live-weight gain from these areas. There is also the possibility of differential response from grass and clover.

There was a very close positive relationship between leaf-stem ratio and nitrogen value of the swards , also shown by Minson (1959) , and a negative relationship with the burn content of herbage.

Figures 30 and 31 (pages 162 and 163 respectively) show the relationship during the year between live-weight gain and quality and quantity of herbage on offer. The value of spring herbage (period 1) is clearly seen . Effects of clover as against pure grass were not very consistent especially as conditions were never comparable. Between commercial and pedigree clover swards , however , they were more obvious. Other factors such as age of sward and degree of selection apparently played some part. The results of period 2 , with relatively stemmy pedigree swards bring these points out clearly. The potential of later grown herbage even of similar nitrogen content is much inferior to spring herbage its value diminishing as the season progressed.

Although a younger animal with a lower digestive efficiency (Raymond et al. , 1954) has been used in period 4 productivity of the herbage seem to decrease from July onwards. Both figures show that quality , quantity and clover content of the swards throughout the year were factors influencing returns. From the range of dry matter produced and the differences in degree of utilisation of swards of the two varieties more than one stocking rate might have given different results.

EXPERIMENT II

Of the first-and second-year Italian ryegrass swards in 1958 the commercial was earlier. Annual production was similar to the pedigree variety. The only advantage from undersowing in autumn is an earlier spring bite since total production for the year was similar to the spring sown swards. The latter was also of higher nitrogen value and established much more quickly. On the second-year swards total yields were more on the commercial under grazing and the reverse under cutting. The latter results may have been influenced by the cutting treatment . There was some indication both from the intake work and the live-weight performance from these swards that the pedigree grass was more efficiently converted than the commercial.

In 1959 the new swards germinated quickly but were not properly established during the year due to the influence of drought and also to that of weeds. This was especially so in the case of the tall fescue-clover swards. Since the yield of tall fescue is small in its first year (Charles , 1955) it would be better to sow it under a nurse crop. The actual live-weight gains during the year were determined by the herbage production (largely weeds) .

In experiment 1 the relative varietal differences were similar to the

previous year. Leaf-stem relationship did not seem to have followed the same pattern as in the previous year with the herbge nitrogen. This was perhaps due to the greater weed proportion , slower herbage growth with shorter grazing intervals and more closely grazed swards.

Thus swards were never in a stemmy or a flowering condition when fed but rather in a comparatively leafy stage.

The uninterrupted cutting treatment gave about 50 per cent more dry matter than the previous interrupted treatment on sites which were having their second year of harvesting. Even so , weed growth on the newer cutting sites were higher. Leaf-stem ratios were generally higher where growth was uninterrupted , which is natural. The topping removed only leaf.

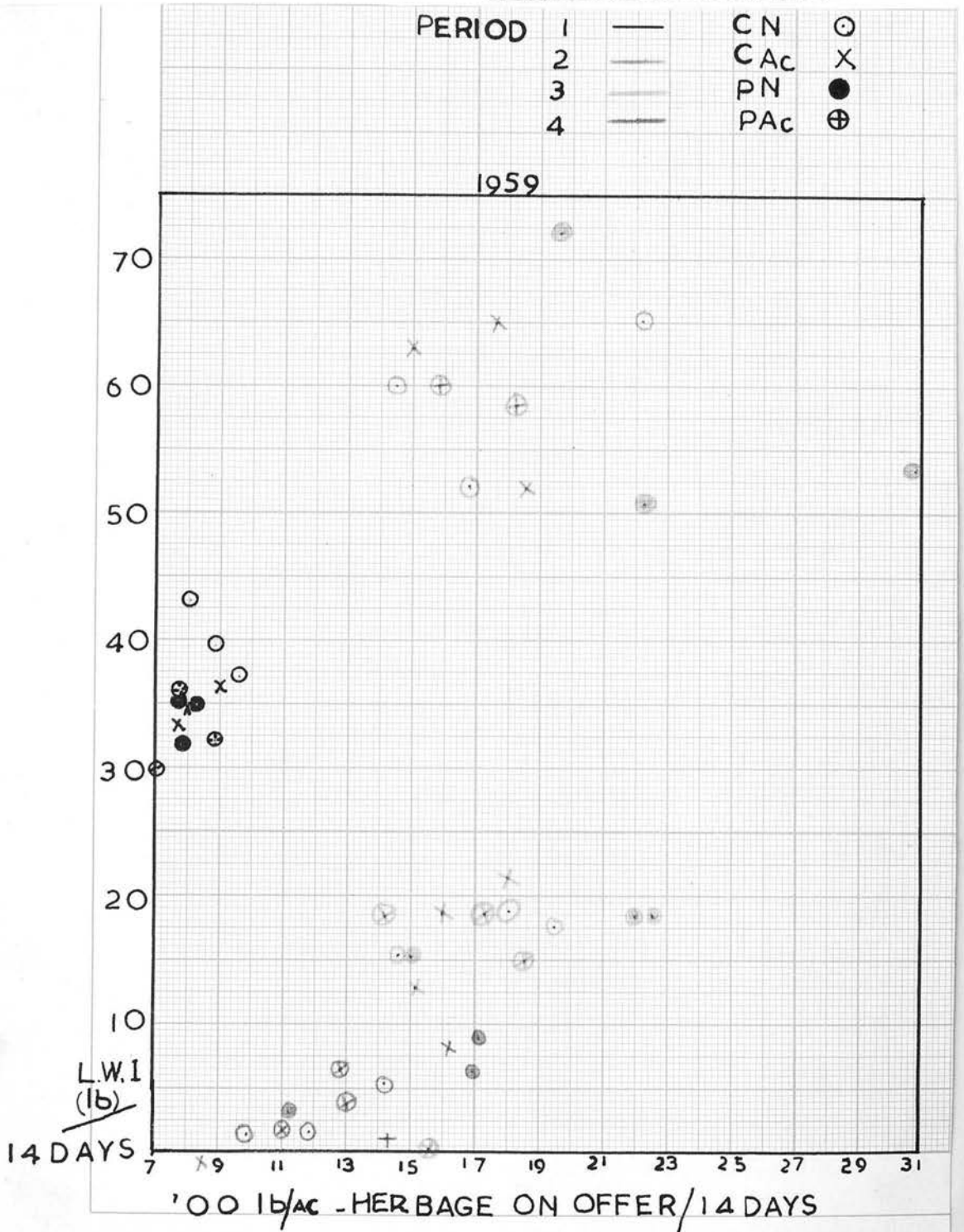
The soil data have not shown any significant differences in carbon and nitrogen values at the beginning and the end of these investigations , but higher values occur on the ryegrass as against the cocksfoot plots in experiment 1 which is similar to results obtained by other workers (Clement , 1958).

The actual increases in carbon and nitrogen status may not be high because of the intensive grazing management. Carbon increases on the pedigree ryegrass swards were very significantly higher than on the commercial plots and this could well be due to the differences in herbage yields which seem to be related to root weight (Garwood ,1959). There were greater nitrogen increases on the commercial swards which may have resulted from quicker breakdown of material.

As in the previous year the intake studies show that live-weight gain was more determined by quality of herbage in late spring, when there were greater differences , and by the amount in autumn , when quality was more alike. Figures 30 and 32 (pages 162 and 167 respectively) also show these points. The limiting factor to animal gains in period 1 appears to have

FIGURE 32 - LIVE-WEIGHT INCREASE AND PERCENTAGE NITROGEN -

HERBAGE ON OFFER/ 14 DAYS



been low herbage yield. Within a fair range of nitrogen values (1.6 in period 2 and 3.6 in period 1) live-weight gains can be substantially increased from 35 to 65 pounds , if enough feed is available. Willoughby (1958) found a similar relationship with Merino ewes.

On the whole the sampling results under both cutting and grazing managements are quite similar except where comparable varieties have not responded similarly to repeated cutting; the commercial varieties appeared to have been affected to a greater degree which could be due to their more erect habit of growth and more easy removal of growing points above ground level. Under good growing conditions a 6-weekly cutting interval may be suitable for this low-level sampling where total available herbage growth is required. Live-weight performances and dry matter production on the various swards did not always fall in the same order and other factors were more important.

During 1958 in experiment 1 differences in herbage quality , quantity and clover contents rendered interpretation of the results difficult but a greater live-weight gain was obtained off the clover treatments. The commercial clover which had the highest clover content gave most live-weight gain. During 1959 when these differences were smaller the amount of clover in the swards was negligible and as quality was quite similar quantity was the most important factor in determining animal performance.

Raymond (1959) has shown that the digestibility of S24 ryegrass is much higher than that of S37 cocksfoot and this factor too must have affected the results. The intake figures throughout showed that the amount of dry matter consumed depended on the leafiness and clover content of the swards in the case of ewe lambs. There appeared to have been a definite bias in this direction because movement of stock from plot to plot was based, not on overgrazing but on quite empirical grounds defined by predetermined

concepts of " good stockmanship" . This has in fact meant that the commercial swards, which invariably produce less herbage , were afforded strikingly better management than that obtained on the pedigree swards during 1958.

A higher stocking rate which could be carried on the pedigree plots would have resulted in greater returns from these swards. Ideally there should have been three rates of stocking , high , medium and low for any one variety. There would sill exist seasonal differences in production and such material could be cut and ensiled. Differences could be measured on a dry matter basis since silage is so variable a product. The assumption is that such cut herbage is very similar from the different swards but to obtain this it may well be that dissimilar stocking rates are required for comparable treatments. Even then the different levels of management would tend to give different results without a common denominator for all three rates of stocking. Differences in area cut also introduces differential management and may invalidate comparisons.

Another method of assessment might be attempted by the zero grazing of swards about 1 inch high which might prove to be the optimum cutting height for a range of materials although there is always the danger of soil contamination when using present day methods of harvesting. It may well be that differences will arise from dry matter output only if it is assumed that live-weight potential per unit dry matter is similar for all swards and for all herbage combinations (this is quite unlikely). If there are differences then these will have to be assessed if progress is to be made in the field of comparative herbage production.

It was not possible to simulate clover-nitrogen release by the application of artificial fertiliser and it seems better to attempt this under adequate and controlled soil moisture conditions and under different

rates of stocking. The soil results showed no significant varietal differences and organic matter development seems to depend primarily on herbage yields and to a lesser degree on species (Clement , 1958). Under grazing conditions herbage appear to reflect differences in quality more easily than soil.

Although the results have not given a final answer to the problem of evaluating varieties , they have shown the factors which need to be controlled if adequate information is to be provided. This solution seems to reside in the realm of differential stocking rates under suitable growing conditions using swards based on one species only or alternatively the use of zero grazing techniques.

The results of the sampling studies show that considerable economy of time and sample size can take place by the use of the sheep shearing equipment used without a loss of sampling efficiency. On average a 50 per cent increase in dry matter yield over that obtained by Tarpen sampling may be expected. This may well be important in helping to understand the reason for differences in live-weight performance which could not otherwise be resolved when using more conventional sampling equipment. The sampling techniques employed appear to have been adequate for estimating the yields which have been recorded throughout this thesis.

CONCLUSION

The results show the difficulties involved in the comparison of commercial and pedigree varieties of grasses when live-weight increases only are used in experimental recording. They are due to differences in persistence as in the case of S24 and Irish perennial ryegrass , and the subsequent intrusion of weeds and clover content which apparently have as great a live-weight potential . Cocksfoot (S37 and Danish) and Italian ryegrass (S22 , Irish and Danish) show smaller differences. One therefore has to be content with a comparison of the swards as they occur. The varieties of each species react differently , for example Danish and Irish Italian , with the result that conclusions drawn are specific only for the material under investigation. When two or more species are used for a varietal comparison as in the present experiments , herbage data of the nature collected are of very great value in supplementing live-weight figures.

It does seem that much more information is required on the behaviour of clover-nitrogen to be able to compare it with fertiliser-nitrogen. The maintenance of the clover percentage in the sward to give these values is also important. It is also possible that there are differences in the feeding value and palatability of a pure grass and grass-clover sward of comparable nitrogen value which will influence liveweight. Varying stocking rates seem to be required to pick up dry matter differences , which are fairly large , and differences in growth patterns.

Because of species differences , one species only should be used primarily and should be coupled with a conservation system. This would enable the rational integration of a complex rotation and the use of different species within such a rotation. There are good indications

that soil organic matter may be associated with herbage yields within species (S24 and Irish perennial ryegrass) .

REFERENCE BIBLIOGRAPHY

Reference Bibliography

Alder , F.E. (1955). J. Brit. Grassl. Soc. 10 , 115-125.

_____ and Redford , R.A. (1958). J. Brit. Grassl. Soc. 13 , 239-246.

Allos , Hazim , F. (1957). Iowa St. Coll. J. Sci. 31 , 350.

Baker , H.K. (1956). J. Brit. Grassl. Soc. 11 , 235-237.

_____ (1957_a). J. Brit. Grassl. Soc. 12 , 116-126.

_____ (1957_b). J. Brit. Grassl. Soc. 12 , 197-201.

Bailey , P.H. , Hughes , M. and McDonald , A.N.C. (1957). J. Brit. Grassl. Soc. 12 , 157-165.

Bartlett , M.S. and Greenhill , A.W. (1936). J. agric. Sci. 26 , 258-262.

Bartlett , S. (1926). J. agric. Sci. 16 , 383-391.

Bates , G.H. (1948). J. Brit. Grassl. Soc. 3 , 177-184.

Blaser , R.E. , Hammes , Jr. , R.C. , Bryant , H.T. , Kincaird , C.M. , Skrdla , W.H., Taylor , T.H. and Griffeth , W.L. (1956). Agron. J. 48 , 508-513.

Blaxter , K.L. (1948). Proc. Brit. Soc. Anim. Prod. 38.

Brandt , P.M. and Ewalt , H.P. (1939). J. Dairy Sci. 18-

Brougham , R.W. (1956). Aust. J. agric. Res. 7 , 377-387.

_____ (1957). Proc. N.Z. Soc. Anim. Prod. 17 , 46-55.

Brown , Dorothy. (1954). Comm. Bur. Past. Fld. Crops. Bull. 42 .

Burger , A.W. , Jackobs , J.A. and Hittle , C.N. (1958). Agron. J. 50 , 37-39.

Carruthers , W. (1882). J. R. agric. Soc. 18 , 364-368.

Cawlishaw , S.J. (1951). J. Brit. Grassl. Soc. 6 , 179-182.

Charles , A.H. (1955). J. agric. Soc. Univ. Coll. Wales.

Clement , C.R. (1958). Ph.D. Thesis - Univ. of Reading.

Cook , C. Wayne , Stoddard , L.A. and Harris , Lorin E. (1951). J. Range Management . 4 , 335-346.

Cooper , J.P. and Saeed , J.W. (1949). J. Ecol. 37 , 233-259.

Corbett , J.L. (1957). J. Brit. Grassl. Soc. 12 , 187-196.

Corkill , L. (1949). Emp. J. exp. Agric. 17 , 157-169.

Cowling , D.W. and Green , J.O. (1954). Europ. Grassl. Conf. 169-174.

Davies , Wm. (1928). Bull. Welsh. Pl. Breed. Sta. 8 , 82-149.

_____ (1939). Bull. Welsh. Pl. Breed. Sta. 15 , 1-24.

_____ (1948). Agriculture , London. 55 , 93-97.

_____ (1955). J. nat. Inst. agric. Bot. V11 , 442-446.

_____ (1931). Welsh. Pl. Breed. Sta. Rep. 1 .

Davies , J.G. and Trumble , H.C. (1934). Bull. Imp. Bur. Pl. Genetics. 14 , 23-32.

Davis , A.G. and Cooper , N.N. (1951). J. Brit. Grassl. Soc. 6 , 229-243.

Donald , C.M. (1941). Univ. Sydney Publ.

Dunlop , G. (1933). J. agric. Sci. 23 , 586-614.

_____ (1935). J. agric. Sci. 25 , 151-159.

Edmond , D. (1957). Proc. 19th. N.Z. Grassl. Ass. 82-89.

Ellett , W.B. and Carrier , Lyman. (1915). J. Amer. Soc. Agron. 7 , 85-87.

Elliott , Robert , H. (1943). Faber and Faber , London.

Expts. in Progress - Grassl. Res. Inst. Hurley. (1957/8). 11 , 19-20.

_____ ($1956/7_a$). 10 , 44-47.

_____ ($1956/7_b$). 10 , 47-51.

Eyles , D.E. , Williams , T.E. and Green , J.O. (1956). Proc. Brit. Soc. Anim. Prod. 91-106.

_____ (1957). Proc. Brit. Soc. Anim. Prod. 17-31.

Fagan , T.W. and Jones , Trefor. (1920-3). Bull. Welsh Pl. Breed. Sta. 3 , 85-130.

_____ and Davies , R.O. (1930). Welsh J. Agric. 6 , 208-223.

Faunce-De Laune. (1882). J. R. agric. Soc. 18 , (229-263.
(604-609.

Forbes , R.M. and Garrigus , W.P. (1948). J. Anim. Sci. 7 , 372-382.

Forbes , R.M. (1949). J. Anim. Sci. 8 , 19-23.

Fream , W. (1888). J. R. agric. Soc. 24 , 415-447.

Fuelleman , R.F. and Burlison , W.L. (1939). J. Amer. Soc. Agron. 31 , 399-413.

Gaponenkov , T.V. et al. (1958). Zimbdelii , Veronez agric. Inst. 6 , 23-26.

Garrigus , W.P. (1934). Proc. Amer. Soc. Anim. Prod. 66-69.

Garwood , E.A. (1959). Unpbl. data.

Gernert , W.B. (1936). J. Amer. Soc. Agron. 28 , 447-456.

Gilchrist , Prof. (1911). Trans. Highl. agric. Soc. Scot. XX111 , 102-112.

Goedewaagen , M.A.J. and Shuurman , J.J. (1950). Trans. 4th. int. Congr. Soil Sci. 2 , 28-31.

Graber , L.F. (1924). J. Amer. Soc. Agron. 16 , 169-172.

Green , J.O. (1948-51). Unpbl. data.

_____ (1948-55). Unpbl. data.

_____ (1949). J. Brit. Grassl. Soc. 4 , 11-16.

_____ (1952). M.Sc. Thesis.

Greenhill , A.W. (1936). Emp. J. exp. Agric. 4 , 274-282.

Haas , H.J. (1958). Agron. J. 50 , 5-9.

Harrison , C.M. and Hodgson , C.W. (1936). J. Amer. Soc. Agron. 31 , 418-430.

Heinemann , W.W. and Van Keuren , R.W. (1958). Agron. J. 50 , 189-192.

Hesse , W.H. and Kennedy , W.K. (1956). Agron. J. 48 , 204-207.

Holmes , W. (1951). J. agric. Sci. 41 , 64-69.

_____ (1954). J. Brit. Grassl. Soc. 9 , 17-27.

Homb , T. and Breirem , K. (1952). J. anim. Sci. 11 , 496-500.

Hudson , A.W. (1933). Imp. Agric.Bull. 11 , 21-35.

_____ , Doak , B.W. and McPherson , G.K. (1933). N.Z. J. Bull. N.Z. Dep. sci. industr. Res. 31 , 1-19.

Hughes , Roy. (1956). Bull. Welsh Pl. Breed. Sta. H.18 .

Hughes , G.P. (1948). Agric , London. 55 , 98-101.

_____ (1951). J. agric. Sci. 41 , 203-213.

_____ (1952). J. agric. Sci. 42 , 413-421.

_____ , and Harker , K.W. (1950). J. agric. Sci. 40 , 403-409.

Hunt , I.V. (1956). Res. Bull. W. Scot. Coll. Agric. 13 .

_____ (1957). J. Brit. Grassl. Soc. 12 , 127-137.

_____ and Thomson , J.M. (1955). Bull. W. Scot. agric. Coll. 152.

Jantii , August and Heinonen , Reijo. (1957). J. Brit. Grassl. Soc. 12 , 56-61.

Jones , M.G. (1933_a). Emp. J. exp. Agric. 1 , 43-57.

_____ (1933_b). Emp. J. exp. Agric. 1 , 122-128.

_____ (1933_c). Emp. J. exp. Agric. 1 , 223-234.

_____ (1933_d). Emp. J. exp. Agric. 1 , 361-367.

Jones , Prof. Martin. (1955). J. Brit. Grassl. Soc. 10 , 107-113.

Jones , Ll. I. (1932). Bull. Welsh Pl. Breed. Sta. 13 , 95-121.

_____ (1936). Emp. J. exp. Agric. 4 , 263-272.

Jones , Martin G. (1928). Welsh J. Agric. 4 , 183-206.

Kane , E.A., Jacobson , W.C. , Ely , R.E. and Moore , L.A. (1953). J. Dairy Sci. 36 , 637-644.

Konekamp, A.H. (1957). Zeitschrift Fur Acker = und Pflanzenbau. 104 , 89-102.

Kopland , D.V. , Post , A.H. and Stitt , R. E. (1954). Bull. Mont. agric. Exp. Sta. 496 .

Lancaster , R.J. (1949). Nature . 163 , 330.

_____ (1949). N.Z. J. Sci. Tech. 31 , 31-38.

Lazenby , Alex. (1957). J.Brit. Grassl. Soc. 12 , 257-263.

Line , C. (1958). The Measurement of Grassland Productivity. 71-78.

Linehan , P.A. and Lowe , J. (1946). J. Brit. Grassl. Soc. 1 , 7-35.

_____ and Stewart , R.H. (1947). J. Brit. Grassl. Soc. 2 , 147-168.

_____ (1952). J. Brit. Grassl. Soc. 7 , 73-98.

List Expts. Grassl. Res. Inst. Hurley. (1957). 18 .

_____ (1958). 24 .

Lynch , P.B. (1947). N.Z. J. Sci. Tech. (agric.). 28 , 385-405.

_____ and Mountier , N.S. (1954). N.Z. J. Sci. Tech. 36 , 375-385.

McDonald , P. and Purves , D. (1957). J. Brit. Grassl. Soc. 12 , 22-29.

McLusky, D.S. (1956). Ph.D. Thesis. University of Glasgow.

Metson , A.J. and Hurst , F.B. (1953). N.Z. J. Sci. Tech. (agric.). 35 , 327-359.

Miller , W.J. , Donker , J.D. , Mahaffey , J.C. , Levy , I. and Dalton , H.L. (1957). Tech.Bull. Georgia Agric. Exp. Stns. 14 .

Milton , W.E.J. and Davies , R.O. (1947). J. Ecol. 35 , 65-95.

Minson , D.J. (1958). Ph.D. Thesis. University of Reading.

_____ (1959). Private Communication.

_____ and Brown , S.A. (1957/8). Grassl. Res. Inst. Hurley Expts. Progr. 99-103.

Morrison , H.B. and Ely , F. (1946). J. Dairy Sci. 29 , 393-405.

Norman , M.J.T. and Green , J.O. (1958). J. Brit. Grassl. Soc. 13 , 39-45.

Oyenuga ,V.A. (1957). Emp. J. exp. Agric. 25 , 237-255.

Percival , Prof. J. (1923/4). J. Minist. Agric. 204-209.

Pidgeon , W.J. and Brisson , Germain , J. (1957). Canad. J. Anim.Sci. 37 , 185.

Prendergast , J.J. and Brady , J.J. (1955_a). J.Brit. Grassl. Soc. 10 , 169-176.

_____ (1955_b). J.Brit.Grassl. Soc. 10 , 213-228.

_____ (1955_c). J.Brit. Grassl. Soc. 10 , 189-190.

Proudfoot , K.G. (1953). Res. Exp. Rec. Min. Agric. N.I. 19-30.

Rampton , H.H. (1946). Oregon Sta. Bull. 427.

Raymond , W.F. (1959). Unpbl. data.

_____ (1948). Nature. 161 ,937-938.

_____ (1953). J. Sci. Fd. Agric. 9 , 409-410.

_____ and Minson , D.J. (1955). J. Brit. Grassl. Soc. 10, 282-296.

_____ and Harris , C.E. (1956). Proc. 7th. Int. Grassl. Cong. (N.Z.). 123-133.

_____ , Jones , E.C. and Harris , C.E. (1955). Agric. Progr. 30 , 120-128.

_____, Kemp , C.D. , Kemp , A.V. and Harris , C.E. (1954). J. Brit. Grassl. Soc. 9 , 69-82.

Reid , D. (1959). J. agric. Sci. 53 , 299-312.

Rhoad , A.O. and Carr , R.B. (1945). Tech. Bull. U.S. Dep. Agric. 890.

Richards , J.A. (1959). Butterworths Scientific Publications - London. 104.

Richards , C.R. , Weaver , H.G. and Connolly , J.D. (1958). J. Dairy Sci. 41 , 956-962.

Roberts , E.J. (1931). Welsh J. Agric. V11 , 187-195.

_____ (1932). Welsh J. Agric. V111 , 84-93.

_____ and Williams , H.M. (1940). Welsh J. Agric. XV1 , 111-131.

Roberts , R.A. and Hunt , I.V. (1936). Welsh J. Agric. 12 , 158-173.

Sears , P.D. (1951). N.Z. J. Sci. Tech. (agric.) 33 , 1 - 29.

_____ (1944). N.Z. J. Sci. Tech. (agric.) 25 , 177-190.

_____ and Thurston , W.G. (1953). N.Z. J. Sci. Tech. (agric.) 34 , 445-459.

_____ and Newbolt , R.P. (1942). N.Z. J. Sci. Tech. (agric.) 24 , 36-61.

_____ and Goodhall , V.C. (1948). N.Z. J. Sci. Tech. (agric.) 30 , 231-239.

Stapledon , R.G. (1957). The Seed Review. 6 .

_____ (1933). Bull. Welsh Pl. Breed. Sta. [illegible] , 12-18 .

Stapledon , R.G. (1920-3). Bull. Welsh Pl. Breed. Sta. 3 , 1 - 80.

_____ , Davies , Wm. , Beddows, A.R. (1923-6). Bull. Welsh Pl. Breed. Sta. 6 , 1 - 63.

_____ (1928). Bull. Welsh Pl. Breed. Sta. 8 , 7-81.

_____ , Fagan, T.W., and Williams , R.D. (1920-3). Bull. Welsh Pl. Breed. Sta. 3 , 159-166.

_____ and Davies , Wm. (1948). Faber and Faber Ltd.

_____ (1925). J. Minist. Agric. 32 , 13-25.

_____ (1949). Agriculture , London. 55 , 461-465.

_____ and Jones , M.G. (1925-6). Bull. Welsh Pl. Breed. Sta. 5 , 42-54.

Sukhatme , P.V. (1946). Nature . 157 , 630.

Sullivan , J.T. and Sprague , V.G. (1943). Plant Physiol. 18 , 656-670.

Taylor , J.C. (1954). Proc. Brit. Soc. Anim. Prod. 3-16.

_____ and Large , R.V. (1955). J. Brit. Grassl. Soc. 10 , 341-351.

Tech. Bull. Edinb. Coll. Agric. (1956). 16 .

_____ (1957). 19 .

Thompson , A. and Raven , A.M. (1955). J. Sci. Fd. Agric. 6 , 769-777.

Troughton , Arthur. (1955). J. Brit. Grassl. Soc. 10 , 197-212.

_____ (1957). Bull. Commonw. Bur. Past. Fld. Crops 44 , 30-34 .

Van Keuren , R.W. and Heinemann , W.W. (1958). Agron. J. 50 , 85-88.

Virtanen , A.I. , von Hausen , S. and Laine , T. (1937). J. agric. Sci. 27 , 332-348.

_____ (1935). J. agric. Sci. 25 , 278-289.

Voison , M. (1957). J. Brit. Grassl. Soc. 12 , 150-154.

Wagner , R.E. (1952). Tech. Bull. U.S. Dep. Agric. 1063 .

Walker , T.W., Orchiston , H.D. and Adams , A.F.R. (1954). J. Brit. Grassl. Soc. 9 , 249-274.

Watkins , B.R. (1954). J. Brit. Grassl. Soc. 9 , 35-46.

_____ (1957). J. Brit. Grassl. Soc. 12 , 264-277.

Watson , S.J. (1950). Nelson . London. 11-29.

_____ , Proctor , J. and Ferguson , W.S. (1932). J. agric. Sci. 22 , 259-290.

_____ (1948). Proc. Brit. Soc. Anim. Prod. 7-20.

_____ and Horton , E.A. (1936_a). Emp. J. exp. Agric. 4 , 25-35.

_____ (1936_b). J. agric. Sci. 26 , 142-154.

Watson , J.A.S. , Skilbeck , D. and Elli , J.C.B. (1933). Agric. Progr. 12, 124-138.

Weaver , J.E. (1958). Ecol. Monogr. 28 , 55-78.

Weinmann , H. (1948). J. Brit. Grassl. Soc. 3 , 115-140.

Williams , T.E. (1949). Proc. 5th. Int. Grassl. Cong. 240.248.

_____ (1947). J. Brit. Grassl. Soc. 2 , 207-212.

_____ (1958). Unpbl. data.

_____ and Baker , H.K. (1957). J. Brit. Grassl. Soc. 12 , 49-55.

Williams , R.D. (1920-3). Bull. Welsh Pl. Breed. Sta. 3 , 131-149.

Williams , S.S. (1951). J. Brit. Grassl. Soc. 6 , 207-217.

Willoughby , W.M.A. (1958). Proc. Aust. Soc. Anim. Prod. 2 , 42-45.

Wolton , K. Margaret. (1955). J. Brit. Grassl. Soc. 10 , 240-253.

Woodman , H.E. , Norman , D.B. and Bee , J.W. (1929). J. agric. Sci. 19 , 236-265.

_____ , Evans , R.E. and Eden , A. (1937_a). J. agric. Sci. 27 , 191-206.

_____ (1937_b). J. agric. Sci. 27 , 212-222.

Young , O.J.B. (1958). J. Brit. Grassl. Soc. 13 , 106-114.

APPENDIX

APPENDIX 1.

(a) METHOD OF BEFORE - AND AFTER-GRAZING SAMPLES - 'O'

Equal numbers of samples were taken from each quarter of each plot (5 or 10). A straight edge six feet long was used as a guide ; each cut was made 6 feet long and the width of the shear head which gave a 3 inch wide sample cut. Each sample cut was thus $1\frac{1}{2}$ square feet in area.

Samples were taken at random over each quarter of each plot by throwing the rod and sampling just where it falls. The samples were cut to ground level and with sharp knives it is possible to cut smooth and straight.

(b) METHOD OF SAMPLING UNDER CAGES - 'C'

These areas were selected at random on each plot and protected by cages 8 or 12 feet long and 4 feet wide. Leaving a six inch margin on both the long sides and one foot on the short sides an area 6 feet by 3 feet was left for sampling, which was done with the use of a 6 feet by one foot quadrat on each occasion , thus providing three possible sites for cutting. A similar technique was employed with the 3 feet by one foot quadrat.

Sampling was done on each of these three sites in order every three weeks so that any one site was sampled at 9-weekly intervals with the sheep shear. After each 3-weekly sampling the entire area for the larger (6' x 1') area was topped back with the Allen Auto-scythe.

APPENDIX 2.

(a) Analysis for Nitrogen

One gram of sample (dried at 100°C) placed in a 500 ml. Kjeldahl flash together with 25 ml. concentrated sulphuric acid , 9.5 grams potassium sulphate and 0.5 grams mercuric oxide , and heated for 2 hours.

After cooling 2 grams of sodium thiosulphate and excess caustic soda is added and the ammonia liberated on boiling is passed into 25 ml. N/10 sulphuric acid. When all the ammonia is evolved the sulphuric acid is back titrated with N/10 sodium hydroxide (x ml.) using methyl red as indicator.

$$\text{Nitrogen } \% = x \times 0.14$$

(b) Analysis for Ash

About 2 grams of sample (dried at 100°C) are weighed into an ashed and weighed silica crucible. The sample is placed in a cold muffle furnace and left for 18 hours by which time the temperature has reached 600°C. The crucible is cooled in a desiccator before weighing.

2. (contd.)

(c) Analysis for Chromic Oxide (After Christian and Coup 1954)

Faeces ash containing 5 - 50 mgs chromic oxide placed in 250 ml conical flask with 5 ml phosphoric acid/manganese sulphate and 5 ml potassium bromate solution. Digest immediately on a hot plate for 7 - 15 minutes. Remove from the hot plate when the effervescence has ceased and a purple colour appears . Allow to cool for 15 - 30 seconds and add 40 ml water from a wash-bottle jet. Add 10 ml sulphuric acid/ manganese sulphate and 5 ml potassium bromate solution. Disperse any solid material adhering to the bottom of the flask into the solution with a glass rod. Boil for 5 minutes , when the solution should be orange red due to free bromine. Avoid bumping by adding plenty of silica chips. Add 100 ml water and 5 ml clearing mixture and boil for 10 minutes. Test for the absence of bromine with starch iodide paper. Cool and titrate with N/20 ferrous ammonium sulphate using ferroin as indicator.

Solutions

1) Potassium Bromate 4.5% solution.

2) Phosphoric acid/manganese sulphate 30 ml 10%.
Manganese sulphate in 1 litre analar orthophosphoric acid.

3) Sulphuric acid/manganese sulphate 5 ml 10% Manganese sulphate in 1 litre 50% sulphuric acid.

4) Clearing mixture . 125 grams ammonium sulphate and 70 ml Analar hydrochloric acid in 1 litre water.

5) N/20 ferrus ammonium sulphate. 100 grams ferrous ammonium sulphate made up to 5 litres with 5% sulphuric acid.

2. (contd.)

(d) Analysis for Normal-acid Fibre (N.A.F.)

One gram of sample (dried at 100°C) is extracted for 8 hours with alcohol-benzene (1 : 2 volumes) in a Soxhlet apparatus. Excess solvent is dried off from the sample which is then transferred to a 500 ml Kjeldahl flask. 200 ml of hot Normal sulphuric acid and 0.2 ml Teepol are added , and the mixture rapidly brought to the boil , and then boiled gently under reflux for 1 hour , with shaking at intervals. The flask is removed from the heater , and the fibre particles allowed to settle. The supernatant liquid is poured through a 50 ml sintered glass crucible (porosity 1) and the fibre washed with three 50 ml lots of hot water. The water is decanted from the first two washings , and the fibre transferred to the crucible with the third washing with the aid of a wash-bottle. The fibre is then washed with alcohol and ether. The crucible is dried to constant weight at 100°C , and the Normal-acid fibre determined by the loss of weight on ignition overnight at 450°C.

2. contd.

(e) Total Soil Carbon Determination

Method

The total soil carbon was determined by the wet digestion method using acidified sodium dichromate then back titrating excess dichromate with standard ferrous sulphate solution using 3-5 drops 1:10 phenanthroline ferrous complex solution as indicator. The end point is observed by a change in the colour of the solution from green to pink.

One or two grams soil was weighed out in a test tube to which was added 12.5 ml conc. H_2SO_4 after adding exactly 5 ml approximately 4N sodium dichromate solution. This was now placed in a large flask to keep the temperature constant. After digesting for $\frac{1}{2}$ hour the entire contents was washed out into a conical flask , indicator added and then titrated against standardised 0.5N ferrous sulphate solution.

APPENDIX 3.

PAIRED SAMPLES - PERENNIAL RYEGRASS SWARD - SPRING, 1958

SAMPLE SIZE	1' x 1'	6' x 3"
No. 1	20	17
2	11	12
3	18	28
4	13	19
5	8	12
6	19.5	24
7	6.5	13
8	22.5	41
9	24	36
10	9	23.5
11	29	40
12	25	28
13	15	33
14	21	28
15	15	33.5
16	15	27
17	14	33
18	18	6
19	10	18
20	3.5	21
21	6	19
22	13	8
23	13.5	35
24	8	13
25	11	9
26	22	37
27	6.5	15
28	22	22.5
29	17	41
30	5	27.5
31	6.5	12
Ex	447.5	488.1
Variance	45.229	48.724

$$\text{Variance } \frac{B}{A} = \frac{48.724}{45.229} = 1.077 \quad \text{N.S.}$$

APPENDIX 4.

(a) METHOD OF COLLECTING FAECES WITH SHEEP -EXPERIMENT 1.

On each plot 15 pegs were placed at random before the sheep were put on the plots. The day before collection started an area of ten square feet around each peg , defined by the use of a wire five and one-half feet long with a hoop at one end , was cleared of all dung and each morning thereafter all the dung within these areas was collected.

As each three day sample was bulked faeces collected on the first of each three day period was stored below freezing until the second day when that day's collection was added to it and the temperature increased to 5 degrees above freezing until the third day when the last day's collection was added and everything thoroughly mixed and sampled for chemical analysis.

(b) METHOD OF COLLECTING FAECES WITH STEERS - EXPERIMENT 11.

After dosing on the day before collection of faeces started all dung pats were covered with lime. This is to enable collection each morning of only the previous 24 hour faeces hence after sampling each pat every morning thereafter it was sprinkled with lime. The total sample collected from the field was thoroughly mixed indoors. This was again sampled , dried for 48 hours and then ground for chemical analysis.

(c) Organic matter intake has been determined by estimating the digestibility and faecal output from the following formula :-

$$\text{INTAKE} = \frac{\text{FAECES} \times 100}{100 - D} \qquad (1)$$

Faecal output was determined by the use of the following formula using chromic oxide :- (1.92 grams in experiment 1 and 9,6 grams in experinent 11) :-

$$Cr_2O_3 \ (O.M.) = Cr_2O_3 \ (D.M.) \times \frac{100}{100 - \text{Ash (in faeces)}} \qquad (2)$$

$$\text{Faecal O.M.} = \frac{\left.\begin{matrix}1.92 \\ 9.6\end{matrix}\right\} \times 1000}{Cr_2O_3 \text{ conc. faecal O.M. (2)}} \qquad (3)$$

(1.92 and 9.6 are assumed to be the amounts of chromic oxide actually recoverable in experiments 1 and 11 respectively).

Digestibilities (D) are worked out by formula of Minson and Brown (1957 - 8) as a result of many digestibility studies undertaken at Hurley using a correction factor for the month (1 - 12 ; January to December).

$$D. = 57.78 + 6.548 \ N - 0.9319 \ m \qquad (4)$$

N = % nitrogen in faecal O.M.
m = month of year

N is determined by the formula :-

$$N \ (O.M.) = \frac{N \ (D.M.) \times 100}{100 \times \text{Ash (Faeces)}} \qquad (5)$$

Field digestibilities by the formula :-

$$D_f = D_i + 6.6 \ (N_f - N_i) \qquad (6)$$

D_f = Field digestibility
D_i = Indoor "
N_f = Field faecal N
N_i = Indoor " "

O.M. intake + 10 % = D.M. intake

APPENDIX 5.

(a) DRY MATTER YIELD, PERENNIAL RYEGRASS-CLOVER'O' (x 100 lbs/ac.)- 1958.

Date	Plot	Tot. DM./ac.	Cor. DM./ac.	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
14.4.58	S24Ac	10.51	7.40	3.11	0.58	4.43	1.60	0.77	0.02
	IrAc.	8.85	6.40	2.45	0.83	3.37	1.04	1.11	0.05
6.5-	"	21.17	19.09	2.08	1.49	11.42	4.13	1.99	0.06
	"	19.20	16.96	2.24	2.20	8.92	2.75	2.95	0.14
S/Tot.	"	31.68	26.49	5.19	2.07	15.85	5.73	2.76	0.08
	"	28.05	23.36	4.69	3.03	12.29	3.79	4.06	0.19
10.6.-	"	25.01	22.61	2.40	2.00	3.80	15.83	0.98	T
	"	22.24	20.53	1.71	2.38	2.49	12.95	2.67	0.04
24.6.-	"	22.90	19.31	3.59	5.86	7.95	3.40	0.80	1.30
	"	24.53	22.03	2.50	10.40	4.00	3.50	3.70	0.43
22.7.-	"	29.17	21.12	8.05	4.03	11.20	4.40	1.49	T
	"	31.04	25.28	5.76	6.77	8.80	4.90	4.69	0.12
28.8.-	"	21.33	15.63	5.70	2.94	8.32	3.35	1.02	T
	"	20.37	16.64	3.73	4.44	5.82	3.22	3.08	0.08
S/Tot.	"	73.40	56.06	17.34	12.83	27.47	11.15	3.31	1.30
	"	75.94	63.95	11.99	21.61	18.62	11.62	11.47	0.63
14.10.-	"	20.69	16.43	4.26	1.22	11.59	1.47	2.15	-
	"	19.84	15.89	3.95	3.10	8.26	0.62	3.91	-
29.10.-	"	23.36	19.04	4.32	4.20	10.92	2.85	1.00	0.07
	"	18.19	16.21	1.98	3.12	6.32	1.64	5.06	0.07
11.11.-	"	19.84	16.96	2.88	3.69	9.69	2.63	0.89	0.06
	"	18.45	16.48	1.97	3.21	6.38	1.64	5.13	0.12
S/Tot.	"	63.89	52.43	11.46	9.11	32.20	6.95	4.04	0.13
	"	56.48	48.58	7.90	9.43	20.96	3.90	14.10	0.19
Grand	"	193.98	157.59	36.39	26.01	79.32	39.66	11.09	1.51
Total	"	182.71	156.42	26.29	36.45	54.36	32.26	32.30	1.05

5. (a) contd. ANALYSES OF VARIANCE

Periods 1 - 4. '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	148,392	74,196	20.217+
S24Ac v IrAc	1	352	352	
Error	2	7,341	3,670	
Total	5	156,085		

(b) Period 3 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	766,444	383,222	2.403
S24Ac v IrAc	1	921,984	921,984	5.782
Error	2	318,916	151,458	
Total	5	2,007,344		

(c) Period 4 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	219.630	109,815	
S24Ac v IrAc	1	225,040	225,040	1.543
Error	2	291,643	145,822	
Total	5	736,313		

(d) Period 1 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	1,683,452	841,726	7.111+
Treatments	3	3,437,341	1,145,780	9.680+
Clover v Nc-C	1	2,395,027	2,395,027	20.233++
Ir v S24	1	913,560	913,560	7.718+
Error	6	710,218	118,370	
Total	11	5,831,011		

5. (e) Period 2 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	2,602,338	1,301,169	8.562+
Treatments	3	2,356,657	785,552	5.169+
Clover v N-C	1	1,112,643	1,112,643	7.322+
Ir v S24	1	896,533	896,533	5.900
Error	6	911,779	151,963	
Total	11	5,870,774		

(f) DRY MATTER YIELD, PERENNIAL RYEGRASS '0' (x100 lbs/ac.)-1958

Date	Plot	Tot. DM./ac.	Cor. DM./ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
14.4.58	S24	11.73	5.81	5.92	4.75	0.88	0.16	0.02
	Ir	6.19	3.89	2.30	2.76	0.58	0.49	0.06
6.5. -	"	21.55	14.13	7.42	11.54	2.13	0.40	0.06
	"	10.83	8.48	2.35	6.01	1.26	1.08	0.13
S/Tot.	"	33.28	19.94	13.34	16.29	3.01	0.56	0.08
	"	17.02	12.37	4.65	8.77	1.84	1.57	0.19
10.6.-	"	23.20	19.89	3.31	10.40	8.45	0.95	0.09
	"	12.27	11.04	1.23	3.99	3.36	3.24	0.45
24.6. -	"	28.32	26.35	1.97	18.35	6.00	1.24	0.76
	"	26.03	25.55	0.48	7.45	6.62	9.14	2.34
28.7 -	"	41.97	30.24	11.73	20.58	5.51	3.18	0.97
	"	32.16	26.56	5.60	11.84	3.72	8.94	2.06
28.8. -	"	20.48	14.83	5.65	10.10	2.72	1.54	0.47
	"	17.39	14.51	2.88	6.50	2.04	4.86	1.11
S/Tot.	"	90.77	71.42	19.35	49.03	14.23	5.96	2.20
	"	75.58	66.62	8.96	25.79	12.38	22.94	5.51
8.10.-	"	25.28	18.56	6.72	13.09	1.39	3.40	0.68
	"	21.33	17.33	4.00	7.30	0.75	7.89	1.39
29.10.-	"	28.32	20.11	8.21	14.59	4.11	1.41	-
	"	23.52	19.84	3.68	11.05	2.30	6.21	0.28
11.11.-	"	25.07	17.81	7.26	12.93	3.63	1.25	-
	"	19.20	16.32	2.88	8.98	1.94	5.18	0.22
S/Tot.	"	78.67	56.48	22.19	40.61	9.13	6.06	0.68
	"	64.05	53.49	10.56	27.33	4.99	19.28	1.89
Grand	"	225.92	167.73	58.19	116.33	34.82	13.53	3.05
Total	"	168.92	143.52	25.40	65.88	22.57	47.03	8.04

5. (f) Contd. ANALYSES OF VARIANCE

Periods 1 - 4 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	151,874	75,937	6.229
S24 v Ir	1	87,604	87,604	7.187
Error	2	24,381	12,190	
Total	5	263,859		

(g) Period 3 '0'

	D.F.	S.S.	M.S.	F
Replicates	2	2,661,487	1,330,744	7.432
S24 v Ir	1	343,204	343,204	1.917
Error	2	358,120	179.060	
Total	5	3,362,811		

(h) Period 4 '0'

	D.F.	S.S.	M.S.	F
Replicates	2	1,159,510	579,755	1.504
S24 v Ir	1	130,538	130,538	
Error	2	770.955	385,478	
Total	5	2,061,003		

5. (i)

DRY MATTER YIELDS , PERENNIAL RYEGRASS-CLOVER '0' (x 100 lbs/ac.)-1959

Date	Plot	Tot. DM/ac.	Cor. DM/ac.	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
7.4.59	S24Ac	12.80	11.68	1.12	0.79	8.11	2.52	0.26	
	IrAc	11.57	10.52	1.05	0.62	5.90	1.46	2.54	
17.4.-	"	13.60	11.70	1.90	0.25	8.95	2.00	0.50	
	"	15.84	14.31	1.53	1.16	8.96	3.05	1.14	
	"	26.40	23.38	3.02	1.04	17.06	4.52	0.76	
S/Tot.	"	27.41	24.83	2.58	1.78	14.86	4.51	3.68	
2.6.-	"	21.07	16.48	4.59	0.44	4.04	7.00	5.00	
	"	20.91	17.33	3.58	1.40	1.59	3.72	10.62	
16.6.-	"	20.37	15.09	5.28	1.00	6.00	4.25	3.84	
	"	19.25	13.33	5.92	1.80	3.00	3.20	5.13	0.20
28.7.-	"	26.13	20.16	5.97	0.60	9.60	6.06	3.90	
	"	27.68	21.01	6.67		4.48	5.14	10.70	0.69
12.8.-	"	28.32	20.27	8.05	1.25	8.20	5.80	5.02	
	"	29.60	20.53	9.07	2.90	4.60	4.90	7.90	0.23
	"	74.82	55.52	19.30	2.85	23.80	16.11	12.76	
S/Tot.	"	76.53	54.87	21.66	4.70	12.08	13.24	23.73	1.12
28.9.-	"	21.49	14.03	7.46	0.38	7.33	3.21	3.11	
	"	18.40	11.81	6.59	1.42	2.37	0.83	7.19	
12.10.-	"	26.61	11.57	15.04	0.16	5.24	2.93	3.24	
	"	25.92	14.45	11.47	1.87	1.40	0.70	10.48	T
	"	48.10	25.60	22.50	0.54	12.57	6.14	6.35	
S/Tot.	"	44.32	26.26	18.06	3.29	3.77	1.53	17.67	T
Grand	"	170.39	120.98	49.41	4.87	57.47	33.77	24.87	
Total	"	169.17	123.29	45.88	11.17	32.30	23.00	55.70	1.12

ANALYSES OF VARIANCE

Periods 1 - 4 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	28,984,245.5	14,492,122.77	20.42^{++}
Treatments	3	9,575,110.0	3,191,703.33	4.50
Clover v no-C	1	4,222,160.3	4,222,160.3	5.95
S24 v Ir	1	1,971,541.3	1,971,541.3	2.78
Error	6	4,258,440.5	709,740.08	
Total	11	42,817,796.0		

5. (j) Period 1 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	19,957.1	9,978.6	
Treatments	3	35,648.2	11,882.7	1.117
Clover v no-C	1	5,084.1	5,084.1	
S24 v Ir	1	28,714.1	28,714.1	2.699
Error	6	63,827.6	10,637.9	
Total	11	119,432.9		

(k) Period 2 '0'

	D.F.	S.S.	M.S.	F
Replicates	2	635,544.00	317,772.00	5.973+
Treatments	3	1,003,119.58	334,373.19	6.285+
Clover v no-C	1	452,796.75	452,796.75	8.510+
S24 v Ir	1	198,404.08	198,404.08	3.729
Error	6	319,234.67	53,205.78	
Total	11	1,957,898.25		

(l) Period 3 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	9,975,141	4,987,570	10.162+
Treatments	3	2,094,524	698,175	1.422
Clover v no-C	1	1,375,664	1,375,664	2.803
S24 v Ir	1	421,500	421,500	
Error	6	2,944,920	490,820	
Total	11	15,014,585		

(m) Period 4 '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	4,926,386	2,463,193	13.429++
Treatments	3	1,043,133	347,711	1.896
Clover v no-C	1	4,408	4,408	
S24 v Ir	1	420,376	420,376	2.292
Error	6	1,100,537	183,423	
Total	11	7,070,056		

5. (n)

DRY MATTER YIELD , PERENNIAL RYEGRASS '0' (x 100 lbs/ac.) - 1959

Date	Plot	Tot. DM/ac.	Cor. DM/ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
7.4.59	S24	11.41	9.94	1.47	8.07	1.28	0.55	0.04
	Ir	11.36	10.37	0.99	7.59	1.05	1.44	0.29
17.4.-	"	14.72	13.76	0.96	10.31	3.02	0.43	
	"	16.96	15.79	1.17	10.38	2.30	3.11	
	"	26.13	23.70	2.43	18.38	4.30	0.98	0.04
S/Tot.	"	28.32	26.16	2.16	17.97	3.35	4.55	0.29
2.6.-	"	27.79	23.79	4.00	14.54	13.23	6.02	
	"	25.55	17.81	7.74	2.04	5.52	10.04	0.21
16.6.-	"	23.95	16.85	7.10	8.70	4.96	3.19	
	"	23.95	16.21	7.74	3.00	2.80	10.21	0.20
28.7.-	"	34.40	24.11	10.29	12.62	5.78	5.71	
	"	26.19	20.05	6.14	4.34	4.92	10.14	0.65
12.8.-	"	35.36	24.75	10.61	12.79	7.26	4.70	
	"	33.49	22.29	11.20	4.00	4.00	14.09	0.20
	"	93.71	65.71	28.00	34.11	18.00	13.60	
S/Tot.	"	83.63	58.55	25.08	11.34	11.72	34.44	1.05
28.9.-	"	25.92	16.48	9.44	10.24	5.01	1.23	
	"	17.33	9.12	8.21	2.16	1.06	5.32	0.58
12.10.-	"	33.44	14.03	19.41	8.39	4.11	1.53	
	"	29.92	13.12	16.80	2.20	0.60	10.32	T
	"	59.36	30.51	28.85	18.63	9.12	2.76	
S/Tot.	"	47.25	22.24	25.01	4.36	1.66	15.64	0.58
Grand	"	206.99	143.71	63.28	75.66	44.65	23.36	0.04
Total	"	184.75	124.76	59.99	35.71	22.25	64.67	2.13

APPENDIX 6.

(a) DRY MATTER YIELD, PERENNIAL RYEGRASS-CLOVER 'C' (x 100 lbs/ac.)-1958.

Date	Plot	Tot. DM./ac.	Cor. DM./ac.	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
9.4.58	S24Ac	13.23	8.43	4.80	1.15	4.37	2.28	0.63	T
	IrAc.	8.11	5.07	3.04	0.64	2.34	1.15	0.94	-
28.4.-	"	26.03	16.32	9.71	2.24	8.45	4.41	1.22	T
	"	22.72	14.88	7.84	1.88	6.87	3.38	2.75	-
19.5.-	"	27.31	17.71	9.60	2.43	9.17	4.78	1.33	T
	"	29.39	19.09	10.30	2.41	8.82	4.33	3.53	-
S/Tot.	"	66.57	42.46	24.11	5.82	21.99	11.47	3.18	T
	"	60.22	39.04	21.18	4.93	18.03	8.86	7.22	-
9.6.-	"	25.97	21.60	4.37	5.09	5.30	9.83	1.09	0.29
	"	23.41	21.33	2.08	7.21	3.22	8.39	2.39	0.12
30.6.-	"	20.11	17.71	2.40	6.19	8.69	0.81	1.30	0.72
	"	19.68	17.97	1.71	8.34	5.60	1.55	2.01	0.47
21.7.-	"	20.27	17.87	2.40	6.24	8.76	0.81	1.34	0.72
	"	21.12	19.15	1.97	8.95	5.96	1.63	2.11	0.50
11.8.-	"	20.96	18.45	2.51	6.46	9.05	0.81	1.38	0.75
	"	18.77	17.07	1.70	7.96	5.30	1.46	1.90	0.45
1.9.-	"	19.04	16.69	2.35	5.86	8.23	0.76	1.21	0.63
	"	16.32	14.88	1.44	6.92	4.64	1.27	1.66	0.39
S/Tot.	"	80.38	70.72	9.66	24.75	34.73	3.19	5.23	2.82
	"	75.89	69.07	6.82	32.17	21.50	5.91	7.68	1.81
22.9.-	"	19.41	17.60	1.81	2.62	12.06	1.27	1.49	0.16
	"	19.20	17.81	1.39	3.55	8.49	0.35	4.88	0.54
13.10.-	"	16.43	14.99	1.44	2.22	10.29	1.08	1.27	0.13
	"	13.92	12.80	1.12	2.58	6.08	0.21	3.54	0.39
3.11.-	"	12.11	11.04	1.07	1.63	7.55	0.83	0.93	0.10
	"	11.04	10.03	1.01	2.04	4.75	0.14	2.80	0.30
S/Tot.	"	47.95	43.63	4.32	6.47	29.90	3.18	3.69	0.39
	"	44.16	40.64	3.52	8.17	19.32	0.70	11.22	1.23
Grand Total	"	220.87	178.41	42.46	42.13	91.92	27.67	13.19	3.50
	"	203.68	170.08	33.60	52.48	62.07	23.86	28.51	3.16

6. (a) contd. ANALYSES OF VARIANCE

Periods 1 - 4 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	213,836.2	106,918	4.583
Treatments	3	127,023.0	42,341	1.815
S24 v Ir.	1	96,481.3	96,481	4.136
Clover v no-C	1	1,925.3	1,925	
Error	6	139,962.5	23,327	
Total	11	480,821.7		

(b) Period 1. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	11,286,426	5,643,213	25.706++
Treatments	3	2,093,876	697,959	3.179
S24 v Ir	1	1,269,451	1,269,451	5.783
Clover v no-C	1	510,469	510,469	2.325
Error	6	1,317,185	219,531	
Total	11	14,697,487		

(c) Period 2. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	17,041	8,520	
Treatments	3	2,907,047	969,016	8.216+
S24 v Ir	1	244,245	244,245	2.071
Clover v no-C	1	2,469,763	2,469,763	20.942++
Error	6	707,615	117,936	
Total	11	3,631,703		

(d) Period 3. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	1,329,847	664,924	1.187
Treatments	3	5,287,685	1,762,562	3.147
S24 v Ir	1	2,134,477	2,134,477	3.811
Clover v no-C	1	1,750,324	1,750,324	3.125
Error	6	3,360,405	560,068	
Total	11	9,977,937		

(e) Period 4. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	2,854,191	1,427,096	6.531+
Treatments	3	3,058,694	1.019,565	4.666
S 24 v Ir	1	5,209	5,209	
Clover v no-C	1	2,709,401	2,709,401	12.399+
Error	6	1,311,084	218,514	
Total	11	7,223,969		

(f) DRY MATTER YIELD, PERENNIAL RYEGRASS 'C' (x 100 lbs/ac.)-1958

Date	Plot	Tot. DM./ac.	Cor. DM./ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
9.4.58	S24	13.65	7.79	5.86	5.89	1.50	0.33	0.07
	Ir	9.17	5.39	3.78	2.30	1.37	1.65	0.07
28.4.-	"	28.00	17.01	10.99	12.87	3.28	0.71	0.15
	"	22.13	12.32	9.81	5.26	3.15	3.77	0.14
19.5.-	"	28.43	16.64	11.79	12.58	3.21	0.70	0.15
	"	26.03	13.97	12.06	5.97	3.56	4.27	0.17
S/Tot.	"	70.08	41.44	28.64	31.34	7.99	1.74	0.37
	"	57.33	31.68	25.65	13.53	8.08	9.69	0.38
9.6.-	"	34.83	33.23	1.60	12.85	17.56	2.40	0.42
	"	29.76	27.84	1.92	6.56	11.82	8.63	0.83
30.6.-	"	28.59	24.37	4.22	18.98	3.50	1.12	0.77
	"	19.89	16.75	3.14	7.48	2.97	6.20	0.10
21.7.-	"	29.71	25.28	4.43	19.70	3.62	1.16	0.80
	"	24.91	20.96	3.95	9.36	3.73	7.75	0.12
11.8.-	"	21.81	18.56	3.25	14.46	2.66	0.85	0.59
	"	22.83	19.31	3.52	8.64	3.44	7.12	0.11
1.9.-	"	19.79	16.91	2.88	13.17	2.44	0.77	0.53
	"	15.09	12.75	2.34	5.70	2.26	4.71	0.08
S/Tot.	"	99.90	85.12	14.78	66.31	12.22	3.90	2.69
	"	82.72	69.77	12.95	31.18	12.40	25.78	0.41
22.9.-	"	18.13	13.65	4.48	10.34	1.41	1.90	-
	"	18.72	15.95	2.77	7.19	0.99	7.30	0.47
13.10.-	"	10.35	7.84	2.51	5.94	0.81	1.09	-
	"	10.56	8.96	1.60	4.04	0.54	4.12	0.26
3.11.-	"	12.11	9.28	2.83	7.00	1.00	1.28	-
	"	11.41	9.60	1.81	4.30	0.56	4.45	0.29
S/Tot.	"	40.59	30.77	9.82	23.28	3.22	4.27	-
	"	40.69	34.51	6.18	15.53	2.09	15.87	1.02
Grand	"	245.40	190.56	54.84	133.78	40.99	12.31	3.48
Total	"	210.50	163.80	46.70	66.80	34.39	59.97	2.64

(g) DRY MATTER YIELD , PERENNIAL RYEGRASS-CLOVER 'C' (x 100 lbs/ac.)-1959.

Date	Plot	Tot. DM/ac.	Cor. DM/ac.	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
31.3.59	S24Ac.	15.73	14.51	1.22	0.50	7.29	2.82	3.90	
	IrAc.	12.91	11.68	1.23	0.85	3.60	1.71	5.52	
20.4.-	"	15.57	14.31	1.26	0.48	7.20	2.78	3.85	
	"	13.49	12.21	1.28	0.89	3.76	1.79	5.77	
11.5.-	"	24.27	22.31	1.96	0.74	11.23	4.33	6.01	
	"	21.87	19.77	2.10	1.44	6.10	2.90	9.33	
	"	55.57	51.13	4.44	1.72	25.72	9.93	13.76	
S/Tot.	"	48.27	43.66	4.61	3.18	13.46	6.40	20.62	
1.6.-	"	22.99	19.68	3.31	1.15	3.45	7.03	7.45	0.60
	"	26.13	20.59	5.54	0.78	1.15	4.73	13.67	0.26
22.6.-	"	16.75	12.48	4.27	0.61	5.91	3.44	2.52	T
	"	14.45	10.35	4.10	0.94	1.81	2.02	4.18	1.40
13.7.-	"	13.87	10.29	3.58	0.49	4.88	2.84	2.08	T
	"	11.73	8.53	3.20	0.78	1.48	1.65	3.48	1.14
3.8.-	"	10.08	7.47	2.61	0.35	3.55	2.07	1.50	T
	"	9.43	6.56	2.87	0.60	1.14	1.25	2.73	0.84
24.8.-	"	15.15	11.20	3.95	0.52	5.32	3.10	2.26	T
	"	12.00	8.69	3.31	0.79	1.51	1.68	3.55	1.16
	"	55.85	41.44	14.41	1.97	19.66	11.45	8.36	T
S/Tot.	"	47.61	34.13	13.48	3.11	5.94	6.60	13.94	4.54
14.9.-	"	10.88	7.61	3.27	0.30	3.16	1.44	2.22	0.49
	"	12.00	10.61	1.39	1.83	0.75	0.22	5.96	1.85
5.10.-	"	6.10	4.53	1.57	0.21	1.83	0.86	1.30	0.33
	"	5.17	4.53	0.64	0.77	0.30	0.09	2.57	0.80
	"	16.98	12.14	4.84	0.51	4.99	2.30	3.52	0.82
S/Tot.	"	17.17	15.14	2.03	2.60	1.05	0.31	8.53	2.65
Grand	"	151.39	124.39	27.00	5.35	53.82	30.71	33.09	1.42
Total	"	139.18	113.52	25.66	9.67	21.60	18.04	56.76	7.45

6. (g) contd. ANALYSES OF VARIANCE

Periods 1 - 4 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	3,902,962.5	1,951,476.2	
Treatments	3	2,000,083.7	666,694.6	
S24 v Ir.	1	1,308,120.3	1,308,120.3	
Clover v no-C	1	230,187.0	230,187.0	
Error	6	12,114,678.8	2,019,113.1	
Total	11	18,017,725.0		

(h) Period 1 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	215,137.5	107,568.8	1.900
Treatments	3	314,158.9	104,719.6	1.850
S24 v Ir.	1	90.7	90.7	
Clover v no-C	1	167,324.0	167,324.0	2.955
Error	6	339,713.8	56,619.0	
Total	11	869,010.2		

(i) Period 2 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	305,231.17	152,615.58	
Treatments	3	209,948.67	69,982.89	
S24 v Ir.	1	147,852.00	147,852.00	
Clover v no-C	1	11,656.34	11,656.34	
Error	6	1,506,182.83	251,030.47	
Total	11	2,021,362.67		

(j) Period 3 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	238,865	119,433	
Treatments	3	2,856,789	952,263	2.897
S24 v Ir.	1	2,247,271	2,247,271	6.836±
Clover v no-C	1	551,694	551,694	1.678
Error	6	1,972,381	328,730	
Total	11	5,068,035		

(k) Period 4 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	136,103	68,052	
Treatments	3	1,355,416	451,805	4.382
S24 v Ir	1	1	1	
Clover v no-C	1	1,149,483	1,149,483	11.148+
Error	6	618,640	103,107	
Total	11	2,110,159		

(1) DRY MATTER YIELD , PERENNIAL RYEGRASS-CLOVER 'C' (x 100 lbs/ac.)-1959

UNINTERRUPTED GROWTH

Date	Plot	Tot. DM/ac.	Cor. DM/ac.	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
31.3.59	S24Ac	11.84	10.13	1.71	T	3.86	4.14	2.13	
	IrAc	21.65	16.16	5.49		2.45	2.75	10.96	
20.4.-	"	29.71	25.39	4.32	T	9.65	10.40	5.34	
	"	29.60	22.13	7.47		3.35	3.77	15.01	
11.5.-	"	66.35	56.75	9.60	T	21.57	23.23	11.95	
	"	58.08	43.36	14.72		6.56	7.38	29.42	
	"	107.90	92.27	15.63	T	35.08	37.77	19.42	
S/Tot.	"	109.33	81.65	27.68		12.36	13.90	55.39	
1.6.-	"	36.32	30.93	5.39	T	5.38	19.50	6.05	
	"	32.75	29.55	3.20	0.46	0.92	5.47	22.70	
22.6.-	"	20.48	15.79	4.69	T	6.83	6.83	2.13	
	"	26.93	22.83	4.10	0.98	3.40	5.58	5.60	7.27
13.7.-	"	11.20	8.64	2.56	T	3.74	3.74	1.16	
	"	6.88	5.76	1.12	0.24	0.86	1.40	1.42	1.84
3.8.-	"	10.51	8.11	2.40	T	3.51	3.51	1.09	
	"	9.97	8.43	1.54	0.36	1.26	2.06	2.07	2.68
24.8.-	"	14.51	11.15	3.36	T	4.82	4.82	1.51	
	"	19.20	16.27	2.93	0.70	2.43	3.97	3.99	5.18
	"	56.70	43.69	13.01	T	18.90	18.90	5.89	
S/Tot.	"	62.98	53.29	9.69	2.28	7.95	13.01	13.08	16.97
14.9.-	"	10.88	8.16	2.72	T	4.67	1.16	0.20	2.13
	"	24.91	17.44	7.47	1.10	0.35	0.35	12.68	2.96
5.10.-	"	2.24	1.71	0.53	T	0.97	0.25	0.04	0.45
	"	9.33	6.56	2.77	0.42	0.14	0.14	4.75	1.11
	"	13.12	9.87	3.25	T	5.64	1.41	0.24	2.58
S/Tot.	"	34.24	24.00	10.24	1.52	0.49	0.49	17.43	4.07
Grand	"	241.04	176.76	37.28	T	65.00	77.58	31.60	2.58
Total	"	239.30	188.49	50.81	4.26	21.72	32.87	108.60	21.04

(m) DRY MATTER YIELD , PERENNIAL RYEGRASS 'C' (x 100 lbs/ac.) - 1959.

Date	Plot	Tot. DM/ac.	Cor. DM/ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
31.3.59	S24	18.35	15.89	2.46	8.46	4.48	2.95	
	Ir	17.17	14.65	2.52	4.70	2.70	7.25	
20.4.-	"	14.40	12.34	2.06	6.59	3.47	2.28	
	"	17.12	14.56	2.56	4.70	2.70	7.16	
11.5.-	"	26.29	22.69	3.60	12.08	6.38	4.23	
	"	32.37	28.18	4.19	9.08	5.15	13.95	
	"	59.04	50.92	8.12	27.13	14.33	9.46	
S/Tot.	"	66.66	57.39	9.27	18.48	10.55	28.36	
1.6.-	"	23.15	18.99	4.16	4.09	11.17	3.73	
	"	26.03	22.51	3.52	1.25	4.89	16.37	
22.6.-	"	15.79	11.68	4.11	4.60	4.90	1.50	0.68
	"	13.44	9.33	4.11	1.30	2.32	4.91	0.80
13.7.-	"	12.27	8.96	3.31	3.55	3.77	1.14	0.50
	"	10.40	7.25	3.15	1.01	1.80	3.81	0.63
3.8.-	"	11.68	8.69	2.99	3.43	3.63	1.12	0.51
	"	6.99	4.91	2.08	0.68	1.24	2.56	0.43
24.8.-	"	12.53	9.17	3.36	3.63	3.85	1.17	0.52
	"	10.19	6.93	3.26	0.95	1.72	3.68	0.58
	"	52.27	38.50	13.77	15.21	16.15	4.93	2.21
S/Tot.	"	41.02	28.42	12.60	3.94	7.08	14.96	2.44
14.9.-	"	7.89	5.28	2.61	2.77	1.14	1.02	0.35
	"	5.07	3.68	1.39	0.60	0.16	2.80	0.12
5.10.-	"	5.87	3.63	2.24	1.98	0.77	0.69	0.19
	"	3.63	2.61	1.02	0.43	0.11	2.00	0.07
	"	13.76	8.91	4.85	4.75	1.91	1.71	0.54
S/Tot.	"	8.70	6.29	2.41	1.03	0.27	4.80	0.19
Grand	"	148.22	117.32	30.90	51.18	43.56	19.83	2.75
Total	"	142.41	114.61	27.80	24.70	22.79	64.49	2.63

(m) DRY MATTER YIELD , PERENNIAL RYEGRASS 'C' (x 100 lbs/ac.) - 1959

UNINTERRUPTED GROWTH

Date	Plot	Tot. DM/ac.	Cor. DM/ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
31.3.59	S24	20.37	16.91	3.46	4.63	4.62	7.66	
	Ir	21.07	17.49	3.58	2.02	2.06	12.41	
20.4.-	"	34.51	28.64	5.87	7.83	7.83	12.98	
	"	30.67	25.55	5.12	2.98	4.47	18.10	
11.5.-	"	66.93	55.57	11.36	15.20	15.20	25.17	
	"	48.11	40.00	8.11	4.64	6.98	28.38	
	"	121.81	101.12	20.69	27.66	27.65	45.81	
S/Tot.	"	99.85	83.04	16.81	9.64	14.51	58.89	
1.6.-	"	43.57	36.85	6.72	6.01	15.42	15.42	
	"	59.84	51.31	8.53	1.58	11.69	38.04	
22.6.-	"	18.45	10.35	8.10	4.30	3.80	2.25	
	"	26.40	22.35	4.05	2.44	3.65	16.26	
13.7.-	"	9.87	5.55	4.32	2.30	2.03	1.22	
	"	14.56	12.32	2.24	1.34	2.01	8.97	
3.8.-	"	5.17	2.93	2.24	1.21	1.08	0.64	
	"	10.67	9.01	1.66	0.97	1.47	6.57	
24.8.-	"	11.68	6.56	5.12	2.72	2.40	1.44	
	"	17.60	14.88	2.72	1.62	2.42	10.84	
	"	45.17	25.39	19.78	10.53	9.31	5.55	
S/Tot.	"	69.23	58.56	10.67	6.37	9.55	42.64	
14.9.-	"	21.71	12.48	9.23	5.24	2.03	2.41	2.80
	"	9.71	7.20	2.51	0.30	0.10	6.80	
5.10.-	"	6.08	3.47	2.61	1.46	0.56	0.67	0.78
	"	8.00	5.92	2.08	0.24	0.08	5.60	
	"	27.79	15.95	11.84	6.70	2.59	3.08	3.58
S/Tot.	"	17.71	13.12	4.59	0.54	0.18	12.40	
Grand	"	238.34	179.31	59.03	50.90	54.97	69.86	3.58
Total	"	246.63	206.03	40.60	18.13	35.93	151.97	

APPENDIX 7.

LEAF-STEM RATIO 'O' and 'C' - 1958.

ANALYSES OF VARIANCE - PERENNIAL RYEGRASS.

(a) Period 1. 'O'

	D.F.	S.S.	M.S.	F.
Replicates	2	.326,436	.163,218	4.857
Treatments	3	.227,005	.075,668	2.252
S24 v Ir	1	.000,981	.000,981	
Clover v no-C	1	.220,025	.220,025	6.548+
Error	6	.201,618	.033,603	
Total	11	.755,059		

Period 1. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.171,834	.085,917	
Treatments	3	.236,483	.078,828	
S24 v Ir	1	.069,662	.069,662	
Clover v no-C	1	.045,276	.045,276	
Error	6	.588,207	.098,034	
Total	11	.996,524		

(b) Period 2. 'O'

	D.F.	S.S.	M.S.	F.
Replicates	2	.106,292,8	.053,146,4	1.773
Treatments	3	1.852,464,9	.617,488,3	20.605++
S24 v Ir	1	.011,831,5	.011,831,5	
Clover v no-C	1	1.835,197,6	1.835,197,6	61.239+++
Error	6	.179,807,9	.029,968,0	
Total	11	2.138,565,6		

7. (b) contd. Period 2. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.271,840,6	.135,920,3	14.998++
Treatments	3	.126,200,3	.042,066,8	4.642
S24 v Ir	1	.044,250,4	.044,250,4	4.883
Clover v no-C	1	.079,235,0	.079,235,0	8.743+
Error	6	.054,374,1	.009,062,4	
Total	11	.452,415,0		

(c) Period 3. 'O'

	D.F.	S.S.	M.S.	F.
Replicates	2	.182,944	.091,472	4.589
Treatments	3	.296,466	.098,822	4.957+
S24 v Ir	1	.225,639	.225,639	11.319+
Clover v no-C	1	.067,335	.067,335	3.378
Error	6	.119,603	.019,934	
Total	11	.599,013		

Period 3. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.132,028	.066,014	
Treatments	3	.466,195	.155,398	1.501
S 24 v Ir	1	.342,901	.342,901	3.313
Clover v no-C	1	.057,063	.057,063	
Error	6	.621,052	.103,509	
Total	11	1.219,275		

7. contd.

(d) Period 4. 'O'

	D.F.	S.S.	M.S.	F.
Replicates	2	.362,202	.181,101	15.052++
Treatments	3	.031,086	.010,362	
S24 v Ir	1	.027,744	.027,744	2.306
Clover v no-C	1	.000,961	.000,961	
Error	6	.072,193	.012,032	
Total	11	.465,481		

Period 4. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.238,321	.119,160	1.842
Treatments	3	.652,714	.217,571	3.363
S24 v Ir	1	.123,059	.123,059	1.902
Clover v no-C	1	.399,821	.399,821	6.181+
Error	6	.388,128	.064,688	
Total	11	1.279,163		

LEAF-STEM RATIO '0' and 'C' -1959

ANALYSES OF VARIANCE - PERENNIAL RYEGRASS

(e) Period 1. '0'

	D.F.	S.S.	M.S.	F.
Replicates	2	.036,060,47	.018,030,24	1.036
Treatments	3	.096,305,96	.032,101,99	1.844
S24 v Ir	1	.002,227,69	.002,227,69	
Clover v no-C	1	.089,596,80	.089,596,80	5.146
Error	6	.104,463,58	.017,410,60	
Total	11	.236,830,01		

Period 1. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.022,250,52	.011,125,26	
Treatments	3	.032,000,15	.010,666,72	
S.24 v Ir	1	.009,318,62	.009,318,62	
Clover v no-C	1	.022,429,46	.022,429,46	
Error	6	.270,392,29	.045,065,38	
Total	11	.324,642,96		

(f) Period 2. '0'

	D.F.	S.S.	M.S.	F
Replicates	2	.120,802,11	.060,401,06	
Treatments	3	.115,829,47	.038,609,82	
S24 v Ir	1	.011,494,83	.011,494,83	
Clover v no-C	1	.075,620,56	.075,620,56	1.15
Error	6	.394,543,91	.065,757,32	
Total	11	.631,175,49		

7. (f) contd.

Period 2. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.029,228,16	.014,614,08	1.59
Treatments	3	.168,622,77	.056,207,59	6.12^{+}
S24 v Ir	1	.151,447,80	.151,447,80	16.48^{++}
Clover v no-C	1	.004,957,26	.004,957,26	
Error	6	.055,122,76	.009,187,13	
Total	11	.252,973,69		

(g)

Period 3. 'O'

	D.F.	S.S.	M.S.	F.
Replicates	2	.004,109	.002,054	
Treatments	3	.133,024	.044,341	1.243
S24 v Ir	1	.098,030	.098,030	2.748
Clover v no-C	1	.033,222	.033,222	
Error	6	.214,049	.035,675	
Total	11	.351,182		

Period 3. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.339,152	.169,576	3.901
Treatments	3	.319,102	.106,393	2.447
S24 v Ir	1	.265,608	.265,608	6.110^{+}
Clover no-C	1	.037,107	.037,107	
Error	6	.260,833	.043,472	
Total	11	.919,165		

7. contd.

(h) Period 4. 'O'

	D.F.	S.S.	M.S.	F.
Replicates	2	.016,160	.008,080	
Treatments	3	.047,338	.015,779	1.316
S24 v Ir	1	.047,175	.047,175	3.935
Clover v no-C	1	.000,103	.000,103	
Error	6	.071,938	.011,989	
Total	11	.135,436		

Period 4. 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.111,090	.055,545	1.503
Treatments	3	.012,970	.004,323	
S24 v Ir	1	.006,315	.006,315	
Clover v no-C	1	.004,140	.004,140	
Error	6	.221,704	.036,951	
Total	11	.345,764		

APPENDIX 8.

YIELD OF BURN -PER CENT - PERENNIAL RYEGRASS AND COCKSFOOT

(a) Period 1

	S24Ac	S37Ac	Dan	Ir	S37	S24	IrAc	DanAc
				'C'				
Block 1	27.5	20.5	43.4	31.4	54.4	24.0	19.0	16.5
2	22.5	33.0	41.1	40.0	45.7	40.0	28.0	19.0
3	34.0	24.0	20.0	17.0	46.0	47.3	30.0	18.0
Total	84.0	77.5	10.45	88.4	146.1	111.3	77.0	53.5
Mean	28.0	25.8	34.8	29.5	48.7	37.1	25.7	17.8
				'O'				
Block 1	11.4	-	-	32.7	-	32.5	21.4	-
2	9.0	-	-	24.0	-	29.3	8.8	-
3	26.5	-	-	16.9	-	37.0	19.5	-
Total	46.9	-	-	73.6	-	98.8	49.7	-
Mean	15.6	-	-	24.5	-	32.9	16.6	-

(b) ANALYSES OF VARIANCE - PERENNIAL RYEGRASS AND COCKSFOOT -'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	89.66	44.83	
Treatments	3	1470.89	490.30	4.822+
Clover v no-C	1	1044.12	1044.12	10.269+
Com. v Ped.	1	380.01	380.01	3.737
Error	6	610.07	101.68	
Main Plots	11	2170 .62		
Species	1	18 .20	18.20	
Tmt. v Species	3	325 .93	108.64	1.900
Error	8	457 .40	57.18	
Total	23	2972 .15		

(c) PERENNIAL RYEGRASS 'O'

	D.F.	S.S.	M.S.	F.
Replicates	2	129.7217	64.8608	1.307
Treatments	3	585.9500	195.3167	3.936+
Clover v no-C	1	478.8034	478.8034	9.649+
S24 v Ir	1	41.8134	41.8134	
Error	6	297.7450		
Total	11	1013.4167		

APPENDIX 9

HERBAGE NITROGEN PER CENT AND ANALYSES OF VARIANCE - P.R.G. - 1958

(a) Period 1 '0'

	S24Ac	Ir	S24	IrAc	Total
Block 1	3.10	3.45	4.31	3.50	14.36
2	3.42	3.62	4.44	2.70	14.18
3	3.22	4.83	4.24	3.57	15.86
Total	9.74	11.90	12.99	9.77	44.40

	D.F.	S.S.	M.S.	F.
Replicates	2	.4254	.2127	1.02
Treatments	3	2.6102	.8701	4.19
Clover v no-C	1	2.4120	2.4120	11.60+
S24 v Ir	1	.0936	.0936	
Error	6	1.2472	.2079	
Total	11	4.2828		

(b) Period 2 '0'

	S24Ac	Ir	S24	IrAc	Total
Block 1	1.92	2.92	2.01	2.14	8.99
2	1.72	3.25	2.87	2.12	9.96
3	1.88	2.98	2.79	2.36	10.01
Total	5.52	9.15	7.67	6.62	28.96

	D.F.	S.S.	M.S.	F.
Replicates	2	0.1654	0.0827	1.22
Treatments	3	2.3920	0.7973	11.8++
Clover v no-C	1	1.8252	1.8252	27.0++
S24 v Ir	1	0.5547	0.5547	8.2+
Error	6	0.4057	0.0676	
Total	11	2.9631		

9. contd.

(c) Period 1 'C'

	D.F.	S.S.	M.S.	F.
Block	2	0.7929	0.3965	3.14
Treatments	3	1.7010	0.5670	4.49
Clover v no-C	1	1.4770	1.4770	11.70+
S24 v Ir	1	0.0080	0.0080	-
Error	6	.7572	.1262	
Total	11	3.2511		

(d) Period 2 'C'

	D.F.	S.S.	M.S.	F.
Block	2	.9133	.4566	4.66
Treatments	3	.9617	.3206	3.27
Clover v no-C	1	.6075	.6075	6.205+
S24 v Ir	1	.0902	.0902	
Error	6	.5875	.0979	
Total	11	2.4625		

(e) Period 3 'C'

	D.F.	S.S.	M.S.	F.
Block	2	0.2102	0.1051	-
Treatments	3	0.4678	0.1559	1.44
Clover v no-C	1	0.2134	0.2134	1.98
S24 v Ir	1	0.0022	0.0022	-
Error	6	0.6474	0.1079	
Total	11	1.3254		

9. contd.

(f) Period 4 'C'

	D.F.	S.S.	M.S.	F.
Block	2	0.0766	0.0383	-
Treatments	3	0.26752	0.0892	1.6
Clover v no-C	1	0.1180	0.1180	2.1
S24 v Ir	1	0.1261	0.1261	2.3
Error	6	0.3345	0.0558	
Total	11	0.6786		

(g) Periods 1 - 4 'C'

	D.F.	S.S.	M.S.	F.
Block	2	6.4433	3.2217	3.52
Treatments	3	3.4479	1.1493	1.26
Clover v no-C	1	1.4146	1.4146	1.55
S24 v Ir	1	0.2700	0.2700	-
Error	6	5.4917	0.9153	
Total	11	15.3829		

HERBAGE NITROGEN PERCENT AND ANALYSES OF VARIANCE - P.R.G. - 1959

(h) Period 1. '0'

	S24Ac	Ir	S24	IrAc	Total
Block 1	3.43	3.12	3.02	3.28	12.85
2	2.98	3.12	3.59	3.08	12.77
3	3.13	3.56	3.31	3.17	13.17
Total	9.54	9.80	9.92	9.53	38.79

	D.F.	S.S.	M.S.	F.
Replicates	2	.022,400	.011,200	
Treatments	3	.037,625	.012,542	
Clover v no-C	1	.035,208	.035,208	
S24 v Ir	1	.001,408	.001,408	
Error	6	.394,200	.065,700	
Total	11	.454,225		

(i) Period 2. '0'

	S24Ac	Ir	S24	IrAc	Total
Block 1	1.94	1.89	1.79	2.08	7.70
2	1.77	1.95	2.02	1.94	7.68
3	1.98	1.99	1.97	1.90	7.84
Total	5.69	5.83	5.78	5.92	23.22

	D.F.	S.S.	M.S.	F.
Replicates	2	.003,800	.001,900	
Treatments	3	.009,233	.003,078	
Clover v no-C	1	.000,000	.0	
S24 v Ir	1	.006,533	.006,533	
Error	6	.073,267	.012,211	
Total	11	.086,300		

(j) Period 3. '0'

	S24Ac	Ir	S24	IrAc	Total
Block 1	2.05	2.20	2.00	2.94	9.19
2	1.67	2.20	2.15	2.14	8.16
3	1.83	1.95	1.92	2.82	8.52
Total	5.55	6.35	6.07	7.90	25.87

	D.F.	S.S.	M.S.	F.
Replicates	2	0.136,617	0.068,308,5	1.09
Treatments	3	1.021,892	0.340,630,7	5.42^{+}
Clover v no-C	1	0.088,409	0.088,409	1.41
S24 v Ir	1	0.576,409	0.576,409	9.16^{+}
Error	6	0.377,383	0.062,897,2	
Total	11	1.535,892		

(k) Period 4. '0'

	S24Ac	Ir	S24	IrAc	Total
Block 1	1.97	2.30	2.13	2.21	8.61
2	1.81	2.21	2.19	2.21	8.42
3	1.80	2.21	2.07	2.34	8.42
Total	5.58	6.72	6.39	6.76	25.46

	D.F.	S.S.	M.S.	F.
Replicates	2	.006,017	.003,009	
Treatments	3	.299,625	.099,875	16.624^{++}
Clover v no-C	1	.049,409	.049,409	8.224^{+}
S24 v Ir	1	.190,009	.190,009	31.626^{++}
Error	6	.036,050	.006,008	
Total	11	.341,692		

(l) Periods 1- 4 'O'

	S24Ac	Ir	S24	IrAc	Total
Block 1	9.39	9.51	8.95	10.51	38.36
2	8.23	9.48	9.95	9.38	37.04
3	8.74	9.71	9.27	10.23	37.95
Total	26.36	28.70	28.17	30.12	113.35

	D.F.	S.S.	M.S.	F.
Replicates	2	0.229,067	0.114,533,5	
Treatments	3	2.405,025	0.801,675,0	2.81
Clover v no-C	1	0.012,675	0.012,675,0	
S24 v Ir	1	1.533,675	1.533,675,0	5.37
Error	6	1.714,600	0.285,766,7	
Total	11	4.348,692		

(m) Period 1 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.024,950	.012,475	1.516
Treatments	3	.098,692	.032,897	3.997
Clover v no-C	1	.001,408	.001,408	
S24 v Ir	1	.025,208	.025,208	3.063
Error	6	.049,383	.008,230	
Total	11	.173,025		

(n) Period 2 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.161,066,7	.080,533,4	15.100++
Treatments	3	.025,825,0	.008,608,3	1.614
Clover v no-C	1	.023,408,3	.023,408,3	4.389
S24 v Ir	1	.001,408,4	.001,408,4	
Error	6	.032,000,0	.005,333,3	
Total	11	.218,891,7		

(o) Period 3 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.012,917	.006,458	
Treatments	3	.110,559	.036,853	
Clover v no-C	1	.027,075	.027,075	
S24 v Ir	1	.072,075	.072,075	1.76
Error	6	.245,816	.040,969	
Total	11	.369,292		

(p) Period 4 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	.338,450	.169,225	3.15
Treatments	3	.198,625	.066,208	1.23
Clover v no-C	1	.031,008	.031,008	
S24 v Ir	1	.110,208	.110,208	2.05
Error	6	.322,750	.053,792	
Total	11	.859,825		

(q) Periods 1 - 4 'C'

	D.F.	S.S.	M.S.	F.
Replicates	2	0.293,217	0.146,608	
Treatments	3	1.250,967	0.420,322	1.82
Clover v no-C	1	0.208,034	0.208,034	
S24 v Ir	1	0.634,800	0.634,800	2.75
Error	6	1.383,583	0.230,597	
Total	11	2.937,767		

APPENDIX 10

INTAKE STUDIES - H 138 - PERENNIAL RYEGRASS -1958

(a) First Study - Faeces

Treatment	Days	Faeces (Grams)	% Ash	Mg. Cr_2O_3 (mmg.)	% N
1: C + N	1-3	363	16.1	4.43	3.23
	4-6	340	16.3	4.73	2.81
	7-9	341	14.1	4.83	2.42
2 : C +Ac	1-3	540	15.1	3.02	3.01
	4-6	471	14.8	3.47	2.84
	7-9	451	14.1	3.66	2.60
3 : P + N	1-3	368	15.7	4.40	3.05
	4-6	342	15.9	4.72	2.76
	7-9	382	14.8	4.28	2.31
4 : P+Ac	1-3	384	15.3	4.23	2.79
	4-6	343	15.5	4.76	2.46
	7-9	502	14.8	3.26	2.12

(b) Second Study - Faeces

1 : C + N	1-3	350	19.3	3.91	2.94
	4-6	357	20.0	4.30	2.87
	7-9	365	20.6	4.18	2.75
2 : C +Ac	1-3	448	19.5	3.45	3.36
	4-6	380	20.9	4.00	3.36
	7-9	312	21.8	4.81	3.28
3 : P+ N	1-3	333	21.1	4.49	3.01
	4-6	273	21.1	5.49	3.05
	7-9	262	20.3	5.84	2.90
4 : P + Ac	1-3	322	21.1	4.07	3.28
	4-6	339	21.7	4.43	3.22
	7-9	291	21.2	5.13	3.13

INTAKE STUDIES - H 138 - PERENNIAL RYEGRASS - 1959

(c) First Study Faeces

Treatment	Days	Faeces (Grams.)	% Ash	Mg. Cr_2O_3 (mmg.)	% N
1 : C + N	1-3	393	13.5	4.23	2.73
	4-6	404	15.3	4.03	2.67
	7-9	417	16.1	3.86	2.47
2 : C + Ac	1-3	403	14.0	4.09	2.79
	4-6	316	17.6	5.00	2.60
	7-9	369	17.8	4.28	2.56
3 : P + N	1-3	339	14.1	4.86	2.57
	4-6	374	15.2	4.35	2.60
	7-9	415	14.9	3.94	2.45
4 : P + Ac	1-3	290	14.4	5.67	2.60
	4-6	233	15.7	6.94	2.51
	7-9	403	18.1	3.90	2.47
(d) Second Study - Faeces					
1 : C + N	1-3	506	15.2	3.22	2.74
	4-6	307	23.7	4.77	2.74
	7-9	387	16.0	4.17	2.46
2 : C + Ac	1-3	477	16.6	3.36	2.84
	4-6	474	17.5	3.34	2.93
	7-9	477	17.5	3.32	2.58
3 : P + N	1-3	331	15.6	4.89	2.56
	4-6	451	15.7	3.59	2.84
	7-9	392	16.0	4.11	2.71
4 : P + Ac	1-3	487	16.6	3.29	2.96
	4-6	375	18.0	4.20	2.94
	7-9	392	18.9	3.97	2.76

APPENDIX 11

(a) SPRING SILAGE YIELDS - PERENNIAL RYEGRASS -1958

LBS/ACRE

	S24Ac	Ir	S24	IrAc
Block 1	3395	2342	4138	3223
2	3342	2159	3412	2587
3	3339	2699	2786	2640
Total	10,076	7200	10,336	8450

(b) Analysis of Variance

	D.F.	S.S.	M.S.	F.
Block	2	435,405	217,702	1.481
Treatments	3	2,161,404	720,468	4.901+
Clover v no-C	1	81,675	81,675	
S24 v Ir	1	1,889,721	1,889,721	12.854+
Error	6	882,109	147.018	
Total	11	3,478,918		

(c) AUTUMN SILAGE YIELDS -PERENNIAL RYEGRASS -1958

LBS/ACRE

	S24Ac	Ir	S24	IrAc
Block 1	2021	1359	1683	1810
2	1663	2282	1691	1597
3	1802	2340	1456	1357
Total	5486	5981	4830	4764

(d) Analysis of Variance

	D.F.	S.S.	M.S.	F.
Block	2	17,801	8,900	
Treatments	3	333,908	11,303	
Clover v no-C	1	26,227	26,227	
S24 v Ir	1	15,337	15,337	
Error	6	791,564	131,927	
Total	11	1,143,273		

(e) SPRING SILAGE YIELDS - PERENNIAL RYEGRASS - 1959

LBS/ACRE

	S24Ac	Ir	S24	IrAc
Block 1	3281	2212	2990	2391
2	3221	1999	2341	3022
3	2828	1375	3025	2676
Total	9330	5586	8356	8089

(f) Analysis of Variance

	D.F.	S.S.	M.S.	F.
Block 1	2	123,885	61,942	
Treatments	3	2,542,958	847,653	5.832+
Clover v no-C	1	1,007,461	1,007,461	6.931+
S24 v Ir	1	1,340,677	1,340,677	9.224+
Error	6	872,100	145,350	
Total	11	3,538,943		

APPENDIX 12.

(a) DRY MATTER YIELD, COCKSFOOT-CLOVER '0' (x100 lbs/ac.) -1958

Date	Plot	Tot. DM./ac.	Cor. D.M./ac.	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
22.4.58.	S37Ac	22.45	10.29	12.16	0.37	8.10	1.30	0.52	T
	DanAc	16.00	10.08	5.92	0.65	5.81	2.90	0.68	0.04
20.5.-	"	19.57	11.95	7.62	0.43	9.41	1.50	0.61	T
	"	15.41	12.80	2.61	0.82	7.37	3.69	0.87	0.05
S/Tot.	"	42.02	22.24	19.78	0.80	17.51	2.80	1.13	-
	"	31.41	22.88	8.53	1.47	13.18	6.59	1.55	0.09
7.7.-	"	15.31	12.75	2.56	0.83	9.47	0.70	1.67	0.08
	"	12.16	9.92	2.24	1.06	6.87	0.52	1.47	T
5.8.-	"	17.23	12.96	4.27	0.74	10.13	0.59	1.50	-
	"	17.17	13.44	3.73	1.43	9.99	0.46	1.51	0.05
11.8.-	"	14.40	12.00	2.40	0.78	8.92	0.66	1.57	0.07
	"	13.49	10.77	2.72	1.16	7.50	0.50	1.61	T
19.8.-	"	16.69	12.59	4.10	0.72	9.85	0.57	1.45	-
	"	15.09	11.79	3.30	1.25	8.76	0.40	1.33	0.05
S/Tot.	"	63.63	50.30	13.33	3.07	38.37	2.52	6.19	0.15
	"	57.91	45.92	11.99	4.90	33.12	1.88	5.92	0.10
9.9.-	"	17.87	14.72	3.15	0.50	9.97	2.98	1.27	-
	"	15.89	13.60	2.29	0.40	9.13	2.47	1.60	-
29.9.-	"	21.01	19.41	1.60	0.67	12.67	3.19	2.82	0.06
	"	19.52	18.08	1.44	0.33	12.88	2.86	2.01	-
S/Tot.	"	38.88	34.13	4.75	1.17	22.64	6.17	4.09	0.06
	"	35.41	31.68	3.73	0.73	22.01	5.33	3.61	-
Grand	"	144.53	106.67	37.86	5.04	78.52	11.49	11.41	0.21
Total	"	124.73	100.48	24.25	7.10	68.31	13.80	11.08	0.19

ANALYSES OF VARIANCE

Periods 1 - 4

	D.F.	S.S.	M.S.	F.
Block	2	30,865	15,432	5.371
S37 v Dan	1	170	170	
Error	2	5,746	2,873	
Total	5	36,781		

12. contd.

(b) Period 1 '0'

	D.F.	S.S.	M.S.	F.
Block	2	1,812,333	906,166	15.856++
Treatments	3	3,164,925	1,054,975	18.459++
Clover v non-C	1	3,117,122	3,117,122	54.542+++
S37 v Dan	1	40,601	40,601	
Error	6	342,907	57,151	
Total	11	5,320,165		

(c) Period 3 '0'

	D.F.	S.S.	M.S.	F.
Block	2	1,129,064	564,532	186.068++
S37 v Dan	1	332,762	332,762	109.678++
Error	2	6,067	3.034	
Total	5	1,467,893		

(d) Period 4 '0'

	D.F.	S.S.	M.S.	F.
Block	2	1,107,016	553,508	8.971
S37 v Dan	1	89,060	89,060	1.443
Error	2	123,401	61,700	
Total	5	1,319,477		

12. contd.

(e) DRY MATTER YIELD, COCKSFOOT '0' (x 100 lbs/ac) - 1958

Date	Plot	Tot. DM./ac.	Cor. DM/ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
22.4.58	S37	39.41	6.40	33.01	5.62	0.60	0.18	-
	Dan	35.11	6.61	28.50	4.40	1.97	0.24	-
20.5.-	"	24.69	5.12	19.57	4.27	0.43	0.42	-
	"	19.79	6.61	13.18	4.12	1.76	0.73	-
S/Tot.	"	64.10	11.52	52.58	9.89	1.03	0.60	-
	"	54.90	13.22	41.68	8.52	3.73	0.97	-
7.7.-	"	23.25	20.96	2.29	17.17	2.67	1.00	0.12
	"	21.81	21.28	0.53	19.18	1.68	0.22	0.20
15.8.-	"	14.51	12.96	1.55	11.20	1.45	0.30	0.01
	"	13.44	12.75	0.69	11.33	1.33	0.09	-
S/Tot	"	37.76	33.92	3.84	28.37	4.12	1.30	0.13
	"	35.25	34.03	1.22	30.51	3.01	0.31	0.20
9.9.-	"	13.28	10.24	3.04	6.78	2.96	0.46	0.04
	"	13.12	8.64	4.48	6.18	1.86	0.60	-
29.9.-	"	14.51	11.04	3.47	8.65	1.87	0.52	-
	"	13.92	11.09	2.83	8.46	2.14	0.49	-
S/Tot.	"	27.79	21.28	6.51	15.43	4.83	0.98	0.04
	"	27.04	19.73	7.31	14.64	4.00	1.09	-
Grand Total	"	129.65	66.72	62.93	53.69	9.98	2.88	0.17
	"	117.19	66.98	50.21	53.67	10.74	2.37	0.20

ANALYSES OF VARIANCE

(e) Period 1 '0'

	D.F.	S.S.	M.S.	F.
Block	2	103,449	51,724	25.505+
S37 v Dan	1	6,338	6,338	3.125
Error	2	4,057	2,028	
Total	5	113,844		

(f) Period 3 '0'

	D.F.	S.S.	M.S.	F.
Block	2	143,256	71,628	4.458
S37 v Dan	1	14,900	14,900	
Error	2	32,137	16,068	
Total	5	190,293		

(g) Period 4 '0'

	D.F.	S.S.	M.S.	F.
Block	2	683,433	341,716	2.446
S37 v Dan	1	36,817	36,817	
Error	2	279,384	139,692	
Total	5	999,634		

(h) DRY MATTER YIELD , COCKSFOOT-CLOVER 'O' (x 100 lbs/ac.) -1959

Date	Plot	Tot. DM/ac.	Cor. DM./ac	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
26.6.59	S37Ac	21.81	10.35	11.46	T	4.76	2.17	3.42	
	DanAc	19.95	9.97	9.98		3.70	1.30	4.13	0.84
8.7.-	"	18.77	9.60	9.17	0.40	4.53	2.27	2.40	
	"	19.09	9.23	9.86	0.60	4.45	1.56	2.62	
20.7.-	"	12.32	5.87	6.45	T	2.71	1.23	1.93	
	"	10.99	5.55	5.44		2.10	0.73	2.25	0.47
25.8.-	"	18.93	16.32	2.61	0.15	9.46	5.04	1.67	T
	"	18.35	15.73	2.62	0.70	9.19	3.47	2.37	T
	"	71.83	42.14	29.69	0.55	21.46	10.71	9.42	
S/Tot.	"	68.38	40.48	27.90	1.30	19.44	7.06	11.37	1.31
8.9.-	"	21.23	19.57	1.66	0.12	11.54	6.30	1.61	T
	"	21.10	19.20	1.90	0.24	9.93	6.99	2.04	
26.10.-	"	14.40	7.52	6.88	0.40	2.65	1.13	3.34	T
	"	13.44	5.44	8.00	0.24	2.00	1.09	1.98	0.13
	"	35.63	27.09	8.54	0.52	14.19	7.43	4.95	T
S/Tot.	"	34.54	24.64	9.90	0.48	11.93	8.08	4.02	0.13
Grand	"	107.46	69.23	38.23	1.07	35.65	18.14	14.37	T
Total	"	102.92	65.12	37.80	1.78	31.37	15.14	15.39	1.44

ANALYSES OF VARIANCE

	D.F.	S.S.	M.S.	F.
Block	2	3,755,357.2	1,877,678.6	1.64
Treatments	3	3,387,595.4	1,129,198.5	
Clover v no-C	1	1,054,947.0	1,054,947.0	
S37 v Ir	1	1,881,792.0	1,881,792.0	1.64
Error	6	6,867,784.1	1,144,630.7	
Total	11	14,010,736.7		

(i) Period 3 'O'

	D.F.	S.S.	M.S.	F.
Block	2	1,112,942	556,471	
Treatments	3	1,701,048	567,016	1.007
Clover v no-C	1	786,944	786,944	1.398
S37 v Dan	1	640,794	640,794	1.138
Error	6	3,378,481	563,080	
Total	11	6,192,471		

(j) Period 4 'O'

	D.F.	S.S.	M.S.	F.
Block	2	961,587	480,794	3.667
Treatments	3	368,074	122,691	
Clover v no-C	1	19,602	19,602	
S37 v Dan	1	326,370	326,370	2.489
Error	6	786,701	131,117	
Total	11	2,116,362		

(k) DRY MATTER YIELD, COCKSFOOT 'O' (x 100 lbs/ac) - 1959

Date	Plot	Tot. DM./ac.	Cor. DM./ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
26.6.59	S37	20.96	12.59	8.37	5.61	3.14	3.84	
	Dan	17.55	8.80	8.75	4.10	1.46	3.24	
8.7.-	"	17.71	11.41	6.30	6.58	3.54	1.29	
	"	15.79	10.19	5.60	5.70	2.60	1.89	
20.7.-	"	15.31	9.17	6.14	4.08	2.29	2.80	
	"	12.96	6.51	6.45	3.02	1.08	2.41	
25.8.-	"	19.36	17.01	2.35	10.00	5.55	1.36	0.10
	"	19.73	17.12	2.61	10.10	4.40	2.62	
	"	73.34	50.18	23.16	26.27	14.52	9.29	0.10
S/Tot.	"	66.03	42.62	23.41	22.92	9.54	10.16	
8.9.-	"	23.68	21.07	2.61	13.17	6.85	1.05	
	"	20.91	19.25	1.66	10.70	7.52	1.03	
26.10.-	"	14.45	7.73	6.72	3.80	2.93	1.00	
	"	11.63	5.39	6.24	2.22	1.01	2.16	
	"	38.13	28.80	9.33	16.97	9.78	2.05	
S/Tot.	"	32.54	24.64	7.90	12.92	8.53	3.19	
Grand	"	111.47	78.98	32.49	43.24	24.30	11.34	0.10
Total	"	98.57	67.26	31.31	35.84	18.07	13.35	

APPENDIX 13

(a) DRY MATTER YIELD , COCKSFOOT-CLOVER 'C' (x 100 lbs/ac.) -1958

Date	Plot	Tot. DM/ac.	Cor. D.M./ac.	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
9.4.58	S37Ac	14.56	9.49	5.07	0.51	5.34	1.94	1.59	0.11
	DanAc	7.52	5.33	2.19	0.76	2.13	1.71	0.69	0.04
28.4.-	"	28.00	16.91	11.09	0.91	9.53	3.45	2.82	0.20
	"	20.11	13.87	6.24	1.98	5.55	4.44	1.79	0.11
19.5.-	"	29.55	18.24	11.31	0.98	10.27	3.72	3.05	0.22
	"	28.32	18.93	9.39	2.71	7.57	6.06	2.44	0.15
S/Tot.	"	72.11	44.64	27.47	2.40	25.14	9.11	7.46	0.53
	"	55.95	38.13	17.82	5.45	15.25	12.21	4.92	0.30
9.6.-	"	21.01	18.67	2.34	1.95	9.76	3.75	2.50	0.71
	"	22.45	19.79	2.66	3.95	8.07	5.50	1.98	0.29
30.6.-	"	13.44	12.21	1.23	2.30	8.18	0.44	0.91	0.38
	"	19.89	16.59	3.30	4.38	8.92	0.62	2.31	0.36
21.7.-	"	18.72	17.07	1.65	3.20	11.43	0.65	1.27	0.52
	"	18.29	15.36	2.93	4.02	8.30	0.59	2.12	0.33
11.8.-	"	14.40	13.12	1.28	2.46	8.79	0.49	0.98	0.40
	"	14.35	11.89	2.46	3.16	6.43	0.44	1.60	0.26
1.9.-	"	13.33	12.16	1.17	2.28	8.15	0.45	0.91	0.37
	"	13.12	10.88	2.24	2.87	5.88	0.41	1.52	0.20
S/Tot.	"	59.89	54.56	5.33	10.24	36.55	2.03	4.07	1.67
	"	65.65	54.72	10.93	14.43	29.53	2.06	7.55	1.15
22.9.-	"	14.45	13.12	1.33	1.57	8.10	1.90	1.41	0.14
	"	15.57	14.24	1.33	1.09	8.95	1.60	2.54	0.06
13.10.-	"	11.15	10.13	1.02	1.22	6.24	1.44	1.12	0.11
	"	11.25	10.35	0.90	0.70	6.47	1.15	1.89	0.05
3.11.-	"	8.75	8.00	0.75	0.95	4.92	1.16	0.88	0.09
	"	9.97	9.23	0.74	0.70	5.79	1.07	1.63	0.04
S/Tot.	"	34.35	31 .25	3.10	3.74	19.26	4.50	3.41	0.34
	"	36.79	33 .82	2.97	2.58	21.21	3.82	6.06	0.15
Grand Total	"	187.36	149.12	38.24	18.33	90.71	19.39	17.44	3.25
	"	180.84	146.46	34.38	26.41	74.06	23.59	20.51	1.89

13. contd.

(a) contd.

ANALYSES OF VARIANCE

Periods 1 - 4 'C'

	D.F.	S.S.	M.S.	F.
Block	2	101,114	50,557	1.602
Treatments	3	102,611	34,204	1.084
Clover v no-C	1	2,437	2,437	
S37 v Dan	1	70,074	70,074	2.220
Error	6	189,409	31,569	
Total	11	393,134		

(b)

Period 1. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	8,248,207	4,124,104	3.277
Treatments	3	5,396,333	1,798,778	1.429
Clover v no-C	1	227,701	227,701	
S37 v Dan	1	4,278,102	4,278,102	3.400
Error	6	7,550,087	1,258,348	
Total	11	21,194,627		

(c)

Period 2. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	75,846	37,923	
Treatments	3	470,078	156,693	
Clover v no-C	1	5,677	5,677	
S37 v Dan	1	138,031	138,031	
Error	6	957,625	159,604	
Total	11	1,503,549		

13. contd.

(d) Period 3. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	1,038,810	519,405	
Treatments	3	448,013	149,338	
Clover v no-C	1	253,752	253,752	
S37 v Dan	1	107,731	107,731	
Error	6	3,825,049	637,508	
Total	11	5,311,872		

(e) Period 4. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	797,916	398,958	4.001
Treatments	3	2,395,083	798,361	8.006^{+}_{++}
Clover v no-C	1	1,734,257	1,734,257	17.391
S37 v Dan	1	94,873	94,873	
Error	6	598,317	99,720	
Total	11	3,791,316		

13. contd.

(f) DRY MATTER YIELD, COCKSFOOT - 'C' (x 100 lbs/ac.) -1958

Date	Plot	Tot. DM./ac	Cor. DM./ac	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
9.4.58	S37	28.85	14.03	14.82	11.29	1.98	0.45	0.31
	Dan	16.96	9.12	7.84	6.09	2.38	0.65	T
28.4.-	"	37.44	18.67	18.77	15.03	2.63	0.60	0.41
	"	22.61	12.32	10.29	8.23	3.22	0.87	T
19.5.-	"	40.53	20.16	20.37	16.23	2.84	0.65	0.44
	"	26.83	13.97	12.86	9.33	3.65	0.99	T
S/Tot.	"	106.82	52.86	53.96	42.55	7.45	1.70	1.16
	"	66.40	35.41	30.99	23.65	9.25	2.51	-
9.6.-	"	24.96	22.40	2.56	17.80	3.50	1.05	0.05
	"	19.47	16.96	2.51	10.40	3.95	2.01	0.60
30.6.-	"	19.84	17.33	2.51	14.48	1.91	0.62	0.32
	"	19.68	17.39	2.29	14.80	1.57	0.70	0.32
21.7.-	"	19.41	17.12	2.29	14.27	1.88	0.66	0.31
	"	20.37	18.29	2.08	15.44	1.67	0.79	0.39
11.8.-	"	13.39	11.73	1.66	9.78	1.29	0.45	0.21
	"	12.27	10.99	1.28	9.30	0.98	0.48	0.23
1.9.-	"	10.93	9.60	1.33	8.01	1.05	0.37	0.17
	"	14.13	12.64	1.49	10.69	1.13	0.55	0.27
S/Tot.	"	63.57	55.78	7.79	46.54	6.13	2.10	1.01
	"	66.45	59.31	7.14	50.23	5.35	2.52	1.21
22.9.-	"	13.23	11.79	1.44	7.88	2.03	1.72	0.16
	"	11.68	9.28	2.40	7.40	1.25	0.63	-
13.10.-	"	10.03	8.96	1.07	5.99	1.55	1.30	0.12
	"	8.53	6.72	1.81	5.37	0.88	0.47	-
3.11.-	"	8.05	7.20	0.85	4.81	1.24	1.05	0.10
	"	7.47	5.87	1.60	4.69	0.77	0.41	-
S/Tot.	"	31.31	27.95	3.36	18.68	4.82	4.07	0.38
	"	27.68	21.87	5.81	17.46	2.90	1.51	-
Grand Total	"	226.66	158.99	67.67	125.57	21.90	8.92	2.60
	"	180.00	133.55	46.45	101.74	21.45	8.55	1.81

(g) DRY MATTER YIELD , COCKSFOOT-CLOVER 'C' (x 100 lbs/ac.) - 1959

INTERRUPTED GROWTH

Date	Plot	Tot. DM/ac	Cor. DM/ac.	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
31.3.59	S37Ac	14.03	11.36	2.67	0.80	2.88	1.42	6.20	0.06
	DanAc	15.25	12.50	2.75	0.56	2.78	1.12	7.74	0.30
20.4.-	"	12.85	10.52	2.33	0.85	2.68	1.35	5.59	0.05
	"	13.11	11.34	1.77	0.55	2.60	1.10	6.73	0.36
11.5.-	"	22.51	17.92	4.59	1.30	4.54	2.20	9.79	0.09
	"	21.33	17.63	3.70	0.80	3.94	1.60	10.86	0.43
	"	49.39	39.80	9.59	2.95	10.10	4.97	21.58	0.20
S/Tot.	"	49.69	41.47	8.22	1.91	9.32	3.82	25.33	1.09
1.6.-	"	24.21	20.43	3.78	1.57	3.36	4.30	11.20	
	"	23.84	19.84	4.00	0.90	3.47	2.97	10.66	1.84
22.6.-	"	13.92	11.15	2.77	0.57	4.94	2.29	2.24	1.11
	"	14.29	11.47	2.82	0.67	6.01	1.93	1.86	1.00
13.7.-	"	14.24	11.41	2.83	0.58	5.04	2.34	2.30	1.15
	"	14.13	11.52	2.61	0.70	5.99	1.95	1.88	1.00
3.8.-	"	13.07	10.67	2.40	0.56	4.68	2.19	2.15	1.09
	"	10.99	8.85	2.14	0.50	4.64	1.50	1.44	0.77
24.8.-	"	14.77	12.00	2.77	0.63	5.26	2.46	2.42	1.23
	"	14.29	11.57	2.72	0.68	6.04	1.96	1.88	1.01
	"	56.00	45.23	10.77	2.34	19.92	9.28	9.11	4.58
S/Tot.	"	53.70	43.41	10.29	2.55	22.68	7.34	7.06	3.78
14.9.-	"	12.16	9.28	2.88	1.17	3.67	2.13	1.75	0.56
	"	8.75	6.99	1.76	0.41	3.32	1.39	0.69	1.18
5.10.-	"	7.57	5.76	1.81	0.73	2.28	1.32	1.09	0.34
	"	6.29	5.01	1.28	0.30	2.38	0.99	0.50	0.84
	"	19.73	15.04	4.69	1.90	5.95	3.45	2.84	0.90
S/Tot.	"	15.04	12.00	3.04	0.71	5.70	2.38	1.19	2.02
Grand	"	149.33	120.50	28.83	8.76	39.33	22.00	44.73	5.68
Total	"	142.27	116.72	25.55	6.07	41.17	16.51	44.24	8.73

(g) DRY MATTER YIELD , COCKSFOOT - ' C ' (x 100 lbs/ac.) - 1959

INTERRUPTED GROWTH

Date	Plot	Tot. DM/ac.	Cor. DM/ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
31.3.59	S37	14.83	13.67	1.16	4.20	2.11	7.27	0.09
	Dan	13.17	11.15	2.02	2.08	0.86	8.21	
20.4.-	"	11.95	11.00	0.95	3.39	1.70	5.84	0.07
	"	14.51	12.25	2.26	2.30	0.95	9.00	
11.5.-	"	21.80	20.39	1.41	6.29	3.14	10.83	0.13
	"	30.61	26.13	4.48	4.86	2.02	19.25	
	"	48.58	45.06	3.52	13.88	6.95	23.94	0.29
S/Tot.	"	58.29	49.53	8.76	9.24	3.83	36.46	
1. 6. -	"	24.32	21.12	3.20	3.65	5.25	12.22	
	"	25.44	20.96	4.48	2.54	4.15	14.27	
22.6.-	"	12.48	8.37	4.11	4.20	1.73	1.82	0.62
	"	18.56	15.25	3.31	7.40	3.06	4.19	0.60
13.7. -	"	12.32	8.16	4.16	4.12	1.68	1.77	0.59
	"	14.24	11.68	2.56	5.68	2.33	3.21	0.46
3. 8.-	"	9.60	6.45	3.15	3.24	1.33	1.40	0.48
	"	7.89	6.61	1.28	3.18	1.33	1.81	0.29
24.8. -	"	16.59	11.04	5.55	5.56	2.28	2.40	0.80
	"	13.17	10.99	2.18	5.30	2.21	3.00	0.48
	"	50.99	34.02	16.97	17.12	7.02	7.39	2.49
S/Tot.	"	53.86	44.53	9.33	21.56	8.93	12.21	1.83
14.9. -	"	10.45	8.43	2.02	4.18	2.62	0.86	0.77
	"	12.75	10.61	2.14	5.66	3.20	1.62	0.13
5.10.-	"	8.64	6.83	1.81	3.40	2.11	0.70	0.62
	"	6.35	5.28	1.07	2.82	1.59	0.81	0.06
	"	19.09	15.26	3.83	7.58	4.73	1.56	1.39
S/Tot.	"	19.10	15.89	3.21	8.48	4.79	2.43	0.19
Grand	"	142.98	115.46	27.52	42.23	23.95	45.11	4.17
Total	"	156.69	130.91	25.78	41.82	21.70	65.37	2.02

(h) DRY MATTER YIELD , COCKSFOOT - ' C ' (x 100 lbs/ac.) - 1959

UNINTERRUPTED GROWTH

Date	Plot	Tot. DM/ac.	Cor. DM/ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
31.3.59	S37	23.41	20.59	2.82	5.08	8.88	6.63	
	Dan	23.89	21.33	2.56	4.63	3.01	13.69	
20.4.-	"	35.04	30.83	4.21	7.60	13.32	9.91	
	"	29.87	26.67	3.20	5.84	3.81	17.02	
11.5.-	"	46.67	41.07	5.60	10.13	17.73	13.21	
	"	46.99	41.97	5.02	9.12	5.92	26.93	
	"	105.12	92.49	12.63	22.81	39.93	29.75	
S/Tot.	"	100.75	89.97	10.78	19.59	12.74	57.64	
1. 6. -	"	34.45	32.05	2.40	6.69	7.17	18.19	
	"	36.48	34.24	2.24	2.59	11.83	18.82	
22.6.-	"	21.33	14.61	6.72	7.20	5.30	2.11	
	"	28.53	23.04	5.49	10.05	4.09	8.90	
13.7.-	"	15.04	10.29	4.75	5.07	3.73	1.49	
	"	20.16	16.27	3.89	7.10	2.88	6.29	
3. 8. -	"	5.60	3.84	1.76	1.90	1.39	0.55	
	"	6.29	5.07	1.22	2.21	0.90	1.96	
24.8.-	"	18.67	12.75	5.92	6.28	4.62	1.85	
	"	11.09	8.96	2.13	3.91	1.59	3.46	
	"	60.64	41.49	19.15	20.45	15.04	6.00	
S/Tot.	"	66.07	53.34	12.73	23.27	9.46	20.61	
14.9. -	"	14.35	10.24	4.11	5.81	2.73	1.02	0.68
	"	9.49	7.52	1.97	2.85	1.28	3.11	0.28
5.10.-	"	6.13	4.37	1.76	2.48	1.16	0.44	0.29
	"	5.39	4.27	1.12	1.61	0.72	1.77	0.17
	"	20.48	14.61	5.87	8.29	3.89	1.46	0.97
S/Tot.	"	14.88	11.79	3.09	4.46	2.00	4.88	0.45
Grand	"	220.69	180.64	40.05	58.24	66.03	55.40	0.97
Total	"	218.18	189.34	28.84	50.91	36.03	101.95	0.45

(g) contd. ANALYSES OF VARIANCE

Periods 1 - 4 'C'

	D.F.	S.S.	M.S.	F.
Block	2	210,211.1	105,105.55	
Treatments	3	4,449,224.9	1,483,074.97	
Clover v no-C	1	646,352.1	646,352.1	
S37 v Dan	1	1,006,302.1	1,006,302.1	
Error	6	15,128,076.9	2,521,346.15	
Total	11	19,787,512.9		

(h) Period 1 'C'

	D.F.	S.S.	M.S.	F.
Block	2	2,666	1,333	
Treatments	3	185,691	61,897	
Clover v no-C	1	147.852	147,852	1.729
S37 v Dan	1	31,212	31,212	
Error	6	513.190	85.532	
Total	11	701,547		

(i) Period 2 'C'

	D.F.	S.S.	M.S.	F.
Block	2	1,579,397.17	789,698.58	26.033++
Treatments	3	30,017.59	10,005.86	
Clover v no-C	1	25,116.75	25,116.75	
S37 v Dan	1	3,640.09	3,640.09	
Error	6	182,008.16	30,334.69	
Total	11	1,791,422.92		

(j) Period 3 'C'

	D.F.	S.S.	M.S.	F.
Block	2	1,177,811	588,906	1.033
Treatments	3	2,451,633	817,211	1.433
Clover v non-C	1	757,519	757,519	1.328
S37 v Dan	1	555,130	555,130	
Error	6	3,421,921	570,320	
Total	11	7,051,365		

(k) Period 4 'C'

	D.F.	S.S.	M.S.	F.
Block	2	37,469	18,735	
Treatments	3	281,870	93,957	2.265
Clover v non-C	1	131,252	131,252	3.165
S37 v Dan	1	44,774	44,774	1.080
Error	6	248.840	41.473	
Total	11	568,179		

(1) DRY MATTER YIELD , COCKSFOOT-CLOVER "C ' (x 100 lbs/ac.) - 1959

UNINTERRUPTED GROWTH

Date	Plot	Tot. DM/ac	Cor. DM/ac	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
31.3.59	S37Ac	18.13	14.13	4.00	T	3.87	3.37	6.89	
	DanAc	16.32	14.51	1.81		4.05	3.49	6.76	0.21
20.4.-	"	18.99	14.77	4.22	T	4.04	3.51	7.22	
	"	18.19	16.16	2.03		4.50	3.88	7.53	0.25
11.5.-	"	64.11	49.87	14.24	T	13.66	11.86	24.35	
	"	63.84	56.80	7.04		15.83	13.66	26.43	0.88
	"	101.23	78.77	22.46	T	21.57	18.74	38.46	
S/Tot.	"	98.35	87.47	10.88		24.38	21.03	40.72	1.34
1.6.-	"	30.03	27.31	2.72	T	7.18	10.30	9.83	
	"	46.99	42.72	4.27		5.26	12.03	23.50	1.93
22.6.-	"	14.29	10.24	4.05		6.83	2.34	1.07	
	"	31.84	26.35	5.49		15.76	7.55	2.04	1.00
13.7.-	"	22.77	16.32	6.45		10.88	3.73	1.71	
	"	13.71	11.36	2.35		6.79	3.25	0.88	0.44
3.8.-	"	14.35	10.29	4.06		6.86	2.35	1.08	
	"	9.92	8.21	1.71		4.91	2.35	0.63	0.32
24.8.-	"	12.11	8.69	3.42		5.79	1.99	0.91	
	"	16.43	13.60	2.83		8.13	3.89	1.05	0.53
	"	63.52	45.54	17.98		30.36	10.41	4.77	
S/Tot.	"	71.90	59.52	12.38		35.59	17.04	4.60	2.29
14.9.-	"	26.08	21.81	4.27		14.36	6.90	0.55	
	"	21.07	18.29	2.78		9.84	5.63	1.41	1.41
5.10.-	"	4.48	3.73	0.75		2.46	1.18	0.09	
	"	6.67	5.81	0.86		3.12	1.79	0.45	0.45
	"	30.56	25.54	5.02		16.82	8.08	0.64	
S/Tot.	"	27.74	24.10	3.64		12.96	7.42	1.86	1.86
Grand	"	225.34	177.16	48.18		75.93	47.53	53.70	
Total	"	244.98	213.81	31.17		78.19	57.52	70.68	7.42

APPENDIX 14.

LEAF-STEM RATIO 'O' AND 'C' -1958

ANALYSES OF VARIANCE - COCKSFOOT.

(a)

Period 1. 'O'

	D.F.	S.S.	M.S.	F.
Block	2	.072,075	.036,038	1.464
Treatments	3	.972,238	.324,079	13.162++
Clover v no-C	1	.031,386	.031,386	1.275
S37 v Dan	1	.926,796	.926,796	37.641+++
Error	6	.147,733	.024,622	
Total	11	1.192,046		

Period 1. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	.371,265	.185,632	2.781
Treatments	3	.942,698	.314,233	4.707
Clover v no-C	1	.443,790	.443,790	6.648+
S37 v Dan	1	.492,602	.492,602	7.379+
Error	6	.400,532	.066,755	
Total	11	1.714,495		

(b)

Period 2. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	.189,149,9	.094,575,0	1.354
Treatments	3	.357,828,7	.119,276,2	1.707
Clover v no-C	1	.176,006,8	.176,006,8	2.519
S37 v Dan	1	.181,081,0	.181,081,0	2.592
Error	6	.419,163,5	.069,860,6	
Total	11	.966,142,1		

14. (c) contd.

(c) Period 3. '0'

	D.F.	S.S.	M.S.	F.
Block	2	.060,068	.030,034	
Treatments	3	.338,578	.112,859	3.743
Clover v no-C	1	.260,986	.260,986	8.656+
S37 v Dan	1	.070,979	.070,979	2.354
Error	6	.180.909	.030.152	
Total	11	.579,555		

Period 3. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	.142,999	.071,500	1.846
Treatments	3	.222,214	.074,071	1.913
Clover v no-C	1	.159,552	.159,552	4.120
S37 v Dan	1	.005,681	.005,681	
Error	6	.232,372	.038,729	
Total	11	.597,585		

(d) Period 4. '0'

	D.F.	S.S.	M.S.	F.
Block	2	.089,616	.044,808	5.957
Treatments	3	.009,108	.003,036	
Clover v no-C	1	.005,043	.005,043	
S37 v Dan	1	.004,019	.004,019	
Error	6	.045,129	.007,522	
Total	11	.143,853		

Period 4. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	.011,825	.005,912	
Treatments	3	.071,505	.023,835	3.054
Clover v no-C	1	.000,069	.000,069	
S37 v Dan	1	.067,741	.067,741	8.679+
Error	6	.046,831	.007,805	
Total	11	.130,161		

LEAF-STEM RATIO 'O' and 'C' - 1959

ANALYSES OF VARIANCE - COCKSFOOT

(e) Period 1. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	.103,683,06	.051,841,53	2.240
Treatments	3	.011,207,75	.003,735,92	
Clover v no-C	1	.007,090,74	.007.090,74	
S37 v Dan	1	.002,787,70	.002,787,70	
Error	6	.138,847,28	.023,141,21	
Total	11	.253,738,09		

(f) Period 2. 'C'

	D.F.	S.S.	M.S.	F.
Block	2	.029,926,40	.014,963,20	
Treatments	3	.150,349,05	.050,116,35	1.63
Clover v no-C	1	.078,392,16	.078,392,16	2.56
S37 v Dan	1	.002,751,24	.002,751,24	
Error	6	.183,949,68	.030,658,28	
Total	11	.364,225,13		

(g) Period 3. 'O'

	D.F.	S.S.	M.S.	F.
Block	2	.001,431	.000,715,5	
Treatments	3	.083,413	.027,804,3	17.890^{++}
Clover v no-C	1	.017,857	.017,857	11.490^{+}
S37 v Dan	1	.064,901	.064,901	41.758^{+++}
Error	6	.009,325	.001,554,2	
Total	11	.094,169		

(g) contd. Period 3. ' C '

	D.F.	S.S.	M.S.	F.
Block	2	.025.042	.012,521	
Treatments	3	.036.861	.012,287	
Clover v no-C	1	.000,884	.000,884	
S37 v Dan	1	.007,712	.007,712	
Error	6	.121,029	.020,172	
Total	11	.182,932		

(h) Period 4. ' O '

	D.F.	S.S.	M.S.	F.
Block	2	.037,694	.018,847	3.219
Treatments	3	.018,628	.006,209	1.061
Clover v no-C	1	.000,166	.000,166	
S37 v Dan	1	.001,738	.001,738	
Error	6	.035,132	.005,855	
Total	11	.091,454		

Period 4. ' C '

	D.F.	S.S.	M.S.	F.
Block	2	.011,743	.005,872	1.467
Treatments	3	.053,401	.017,800	4.448
Clover v no-C	1	.023,595	.023,595	5.896
S37 v Dan	1	.020,214	.020,214	5.053
Error	6	.024,011	.004,002	
Total	11	.089,155		

APPENDIX 15.

YIELD OF BURN - PER CENT - COCKSFOOT

(a) Period 1. '0'

	S37 Ac	Dan	S37	Dan Ac
Block 1	27.5	50.5	53.0	8.0
2	35.0	59.7	70.0	22.5
3	34.5	51.0	70.0	21.0
Total	97.0	161.2	193.0	51.5
Mean	32.3	53.7	64.3	17.2

(b) ANALYSIS OF VAIRANCE - COCKSFOOT - '0'

	D.F.	S.S.	M.S.	F.
Block	2	320.3317	160.1658	10.896^{+}
Treatments	3	4039.6225	1346.5408	91.606^{+++}
Clover v no-C	1	3526.0409	3526.0409	239.880^{+++}
S37 v Dan	1	497.9409	497.9409	33.875^{++}
Error	6	88.1950	14.6992	
Total	11	4448.1492		

APPENDIX 16.

HERBAGE NITROGEN PER CENT AND ANALYSES OF VARIANCE - COCKSFOOT - 1958

(a) Period 1. '0'

	S37 Ac	Dan	S37	Dan Ac	Total
Block 1	3.27	3.18	4.77	3.26	14.48
2	4.58	3.30	2.87	3.26	14.01
3	3.25	3.64	2.98	3.74	13.61
Total	11.10	10.12	10.62	10.26	42.10

	D.F.	S.S.	M.S.	F.
Block	2	0.0949	0.0475	
Treatments	3	0.1913	0.0638	
Clover v no-C	1	0.0321	0.0321	
S37 v Dan	1	0.1497	0.1497	
Error	6	3.6098	0.6016	
Total	11	3.8960		

(b) Periods 1-4 '0'

	S37 Ac	Dan	S37	Dan Ac	Total
Block 1	10.54	11.74	11.04	9.74	43.06
2	9.36	13.32	12.17	10.90	45.75
3	9.67	13.42	12.54	9.53	45.16
Total	29.57	38.48	35.75	30.17	133.97

	D.F.	S.S.	M.S.	F..
Block	2	0.9995	0.4998	
Treatments	3	18.7988	6.2663	9.80^{++}
Clover v no-C	1	17.4967	17.4967	27.4^{++}
S37 v Dan	1	0.9241	0.9241	1.45
Error	6	3.8354	0.6392	
Total	11	23.6337		

16. contd.

(c) Period 1. 'C'

	S37 Ac	Dan	S37	DanAc	Total
Block 1	3.05	3.72	3.61	2.56	12.94
2	2.87	4.34	4.05	3.09	14.35
3	2.46	3.80	3.98	2.46	12.61
Total	8.38	11.86	11.55	8.11	39.90

	D.F.	S.S.	M.S.	F.
Block	2	0.4271	0.2136	4.11
Treatments	3	4.0187	1.3396	25.76^{+++}
Clover v non-C	1	3.9905	3.9905	76.7^{+++}
S37 v Dan	1	0.0001	0.0001	
Error	6	0.3117	0.0520	
Total	11	4.7575		

(d) Period 2. 'C'

	S37 Ac	Dan	S37	DanAc	Total
Block 1	2.08	2.76	2.74	2.13	9.71
2	1.73	3.10	2.93	2.33	10.09
3	1.80	3.29	3.00	1.97	10.06
Total	5.61	9.15	8.67	6.43	29.86

	D.F.	S.S.	M.S.	F.
Block	2	0.0224	0.0112	
Treatments	3	2.9345	0.9782	20.13^{++}
Clover v non-C	1	2.7841	2.7841	57.29^{+++}
S37 v Dan	1	0.1409	0.1409	2.90
Error	6	0.2917	0.0486	
Total	11	3.2486		

16. contd.

(e) Period 3. 'C'

	S37 Ac	Dan	S37	DanAc	Total
Block 1	2.31	2.61	2.26	2.50	9.68
2	2.27	3.02	2.48	2.68	10.45
3	2.62	3.11	2.97	2.49	11.19
Total	7.20	8.74	7.71	7.67	31.32

	D.F.	S.S.	M.S.	F.
Block	2	0.2851	0.1426	3.94
Treatments	3	0.4217	0.1406	3.88
Clover v nc-C	1	0.2080	0.2080	5.75
S37 v Dan	1	0.1875	0.1875	5.18
Error	6	0.2174	0.0362	
Total	11	0.9242		

(f) Period 4. 'C'

	S37 Ac	Dan	S37	DanAc	Total
Block 1	3.10	2.65	2.43	2.55	10.73
2	2.49	2.86	2.71	2.80	10.86
3	2.79	3.22	2.68	2.61	11.30
Total	8.38	8.73	7.82	7.96	32.89

	D.F.	S.S.	M.S.	F.
Block	2	0.0446	0.0223	
Treatments	3	0.1711	0.0570	
Clover v nc-C	1	0.0037	0.0037	
S37 vDan	1	0.0200	0.0200	
Error	6	0.3890	0.0648	
Total	11	0.6047		

HERBAGE NITROGEN PER CENT AND ANALYSES OF VARIANCE - COCKSFOOT -1959

(g) Period 3. '0'

	S37 Ac	Dan	S37	Dan Ac	Total
Block 1	2.45	2.01	2.12	1.73	8.31
2	1.68	2.19	2.18	1.86	7.91
3	2.01	2.28	1.99	1.96	8.24
Total	6.14	6.48	6.29	5.55	24.46

	D.F.	S.S.	M.S.	F.
Block	2	0.022,817	0.011,408,5	
Treatments	3	0.161,234	0.053,744,7	
Clover v no-C	1	0.097,200	0.097,200,0	1.62
S37 v Dan	1	0.013,334	0.013,334,0	
Error	6	0.358,916	0.059,819,3	
Total	11	0.542,967		

(h) Period 4. '0'

	S37 Ac	Dan	S37	Dan Ac	Total
Block 1	2.19	2.44	2.24	1.93	8.80
2	1.85	2.29	2.35	1.94	8.43
3	1.66	2.23	1.93	2.28	8.10
Total	5.70	6.96	6.52	6.15	25.33

	D.F.	S.S.	M.S.	F.
Block	2	0.061,317	0.030,659	
Treatments	3	0.287,425	0.095,808	2.049
Clover v no-C	1	0.221,409	0.221,409	4.735
S37 v Dan	1	0.066,009	0.066,009	1.412
Error	6	0.280,550	0.046,758	
Total	11	0.629,292		

(i) Periods 3 - 4 . ' 0 '

	S37 Ac	Dan	S37	Dan Ac	Total
Block 1	4.64	4.45	4.36	3.66	17.11
2	3.53	4.48	4.53	3.80	16.34
3	3.67	4.51	3.92	4.24	16.34
Total	11.84	13.44	12.81	11.70	49.79

	D.F.	S.S.	M.S.	F.
Block	2	0.098,817	0.049,409	
Treatments	3	0.681,425	0.227,142	1.342
Clover v no-C	1	0.612,009	0.612,009	3.617
S37 v Dan	1	0.020,009	0.020,009	
Error	6	0.015,250	0.169,208	
Total	11	1.795,492		

(j) Period 1. 'C '

	S37 Ac	Dan	S37	Dan Ac	Total
Block 1	2.49	2.25	2.34	2.20	9.28
2	2.32	2.71	2.74	2.68	10.45
3	2.40	2.84	2.99	2.35	10.58
Total	7.21	7.80	8.07	7.23	30.31

	D.F.	S.S.	M.S.	F.
Block	2	.256,316, 7	.128,158,4	2.689
Treatments	3	.182,625,0	.060,875,0	1.277
Clover v no-C	1	.170,408,3	.170,408,3	3.576
S37 v Dan	1	.005,208,3	.005,208,3	
Error	6	.285,950,0	.047,658,3	
Total	11	.724,891,7		

(k) Period 2. ' C '

	S37 Ac	Dan	S37	Dan Ac	Total
Block 1	1.72	1.49	1.33	1.52	6.06
2	1.59	1.80	1.85	1.73	6.97
3	1.78	1.97	1.75	1.61	7.11
Total	5.09	5.26	4.93	4.86	20.14

	D.F.	S.S.	M.S.	F.
Block	2	.162,516,7	.081,258,4	3.266
Treatments	3	.031,766,7	.010,588,9	
Clover v no-C	1	.004,800,0	.004,800,0	
S37 v Dan	1	.000,833,4	.000,833,4	
Error	6	.149,283,3	.024,880,6	
Total	11	.343,566,7		

(l) Period 3 ' C '

	S37Ac	Dan	S37	DanAc	Total
Block 1	2.32	2.05	2.18	2.03	8.58
2	1.98	2.19	1.93	2.02	8.12
3	2.13	2.32	1.95	2.30	8.70
Total	6.43	6.56	6.06	6.35	25.40

	D.F.	S.S.	M.S.	F.
Block	2	0.046,867	0.023,434	1.03
Treatments	3	0.044,867	0.014,956	
Clover v no-C	1	0.002,134	0.002,134	
S37 v Dan	1	0.014,700	0.014,700	
Error	6	0.136,733	0.022,789	
Total	11	0.228,467		

(m) Period 4 'C'

	S37Ac	Dan	S37	DanAc	Total
Block 1	2.52	2.15	2.16	2.32	9.15
2	2.39	2.03	2.12	2.44	8.98
3	2.34	2.55	2.06	2.27	9.22
Total	7.25	6.73	6.34	7.03	27.35

	D.F.	S.S.	M.S.	F.
Block	2	0.007,617	0.003,808	
Treatments	3	0.155,425	0.051,808	1.74
Clover v no-C	1	0.122,009	0.122,009	4.11
S37 v Dan	1	0.002,409	0.002,409	
Error	6	0.178,250	0.029,708	
Total	11	0.341,292		

(n) Periods 1 - 4 'C'

	S37Ac	Dan	S37	DanAc	Total
Block 1	9.05	7.94	8.01	8.07	33.07
2	8.28	8.73	8.64	8.87	34.52
3	8.65	9.68	8.75	8.53	35.61
Total	25.98	26.35	25.40	25.47	103.20

	D.F.	S.S.	M.S.	F.
Block	2	0.811,850	0.405,925	1.48
Treatments	3	0.201,267	0.067,089	
Clover v no-C	1	0.007,500	0.007,500	
S37 v Dan	1	0.016,133	0.016,133	
Error	6	1.644,083	0.274,014	
Total	11	2.657,200		

APPENDIX 17.

(a) SPRING SILAGE YIELDS - COCKSFOOT - 1958

LBS/ACRE

	S37Ac	Dan	S37	Dan Ac
Block 1	3158	3356	3286	4717
2	2988	3617	3557	2940
3	2729	3688	3856	3267
Total	8875	10,661	10,699	10,924

Analysis of Variance

	D.F.	S.S.	M.S.	F.
Block	2	262,383	131,192	
Treatments	3	903,034	301,011	
Clover v no-C	1	203,060	203,060	
S37 v Dan	1	337,010	337,010	1.097
Error	6	1,843,720	307,287	
Total	11	3,009,137		

(b) AUTUAMN SILAGE YIELDS - COCKSFOOT - 1958

LBS/ACRE

	Dan	S37
Block 1	1500	1605
2	1459	1844
3	1933	1882
Total	4892	5331

Analysis of Variance

	D.F.	S.S.	M.S.	F.
Block	2	134,242	67,121	2.751
Treatments				
(S37 v Dan)	1	32,120	32,120	1.316
Error	2	48,805	24,402	
Total	5	215,167		

17. contd.

(c) HAY YIELDS - COCKSFOOT -1958
LBS/ ACRE

	S37 Ac	Dan	S37	Dan Ac
Block 1	2178	3354	3350	3059
2	1980	3179	3166	1544
3	1609	3073	2712	1150
Total	5767	9606	9228	5753

Analysis of Variance

	D.F.	S.S.	M.S.	F.
Block	2	1,465,702	732,851	4.447
Treatments	3	4,481,730	1,493,910	9.066+
Clover v no-C	1	4,457,883	4,457,883	27.053++
S37 v Dan	1	11,041	11,041	
Error	6	988,693	164,782	
Total	11	6,936,125		

(d) SPRING SILAGE YIELDS (lbs./ac) - COCKSFOOT - 1959

	S37 Ac	Dan	S37	Dan Ac
Block 1	7968	7558	7015	7283
2	7347	8310	6919	7318
3	6569	7960	7784	6545
Total	21,884	23,828	21,718	21,146

Analysis of Variance

	D.F.	S.S.	M.S.	F.
Block	2	167,613	83,806	
Treatments	3	1,360,312	453,437	1.410
Clover v no-C	1	527,522	527,522	1.641
S37 v Dan	1	156,866	156,866	
Error	6	1,929,032	321,505	
Total	11	3,456,957		

APPENDIX 18.

(a) DRY MATTER YIELDS - ITALIAN RYEGRASS -PLOT 3 (x100lbs/ac.)-1958

Date	Plot	Tot. DM./ac.	Cor. DM./ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds	Plot DM.	Rye
3.7.58	3A 1	13.49	13.26	0.23	4.02	8.86	0.38	-	12.69	-
	3B 1	13.19	13.07	0.12	2.72	8.06	0.41	1.88	9.61	-
	3A 2	14.28	14.21	0.07	8.64	0.84	3.20	1.53	11.98	-
	3B 2	7.92	7.90	0.02	3.14	0.80	0.82	2.65	8.41	0.49
13.8.-	"	15.26	15.00	0.26	4.55	10.03	0.42	-	14.35	-
	"	13.41	13.30	0.11	2.76	8.19	0.43	1.92	9.77	-
	"	15.02	14.94	0.08	9.08	0.89	3.36	1.61	12.61	-
	"	16.57	16.52	0.05	6.58	1.67	1.72	5.52	17.50	1.03
8.9.-	"	14.21	10.42	3.79	6.44	2.84	1.14	-	9.96	-
	"	12.14	9.04	3.10	4.09	2.47	1.24	0.24	6.65	-
	"	12.18	9.83	2.35	7.04	1.77	1.02	-	8.29	-
	"	14.45	12.83	1.62	9.09	2.38	0.46	0.90	13.60	-
3.11.-	"	15.71	11.52	4.19	7.12	3.14	1.26	-	11.02	-
	"	15.04	11.20	3.84	5.07	4.30	1.53	0.30	8.23	-
	"	14.07	11.35	2.72	8.13	2.04	1.18	-	9.58	-
	"	15.47	13.74	1.73	9.73	2.55	0.50	0.96	14.63	-
	"	58.67	50.20	8.47	22.13	24.87	3.20	-	48.02	-
	"	53.78	46.61	7.17	14.64	24.02	3.61	4.34	34.26	-
Total										
	"	55.55	50.33	5.22	32.89	5.54	8.76	3.14	42.46	-
	"	54.41	50.99	3.42	28.54	7.40	3.50	10.03	54.14	1.52
Grand Total	3A	114.22	100.53	13.69	55.02	30.41	11.96	3.14	90.49	-
	3B	108.19	97.60	10.59	43.18	31.42	7.11	14.37	88.40	1.52

18. contd.

(b) DRY MATTER YIELDS -ITALIAN RYEGRASS -PLOT 3 (x100lbs/ac)-1958

' C '

Date	Plot	Tot. Dm./ac.	Cor. DM./ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds	Rye
3.6.58	3A1	13.86	13.86	-	2.13	4.20	1.14	0.10	6.29
	3B1	30.41	30.41	-	4.48	13.11	1.06	4.01	7.75
24.6.-	3A1	9.28	9.12	0.16	3.94	4.52	0.58	0.08	-
	3B1	9.15	8.05	1.10	2.42	4.89	0.36	0.38	-
	3A2	23.09	22.49	0.60	15.66	5.13	1.70	-	-
	3B2	26.14	25.80	0.34	11.79	3.32	1.65	2.74	6.30
15.7.-	"	18.03	17.72	0.31	7.66	8.78	1.12	0.16	-
	"	21.35	18.79	2.56	5.66	11.40	0.83	0.90	-
	"	34.02	33.14	0.88	23.07	7.55	2.52	-	-
	"	18.93	18.68	0.25	8.54	2.40	1.19	1.99	4.56
5.8.-	"	26.85	26.39	0.46	11.41	13.08	1.66	0.24	-
	"	13.00	11.44	1.56	3.45	6.94	0.51	0.54	-
	"	34.47	33.57	0.90	23.37	7.65	2.55	-	-
	"	18.99	18.63	0.26	8.52	2.40	1.19	1.98	4.54
26.8.-	"	22.78	22.39	0.39	9.68	11.09	1.41	0.21	-
	"	12.62	11.11	1.51	3.34	6.75	0.49	0.53	-
	"	20.69	20.15	0.54	14.03	4.59	1.53	-	-
	"	17.34	17.11	0.23	7.82	2.20	1.09	1.82	4.18
16.9.-	"	15.39	12.94	2.45	8.66	3.85	0.31	0.12	-
	"	11.00	9.36	1.64	3.29	2.30	2.96	0.81	-
	"	8.79	8.09	0.70	5.28	2.72	0.09	-	-
	"	12.91	10.21	2.70	7.71	0.54	1.25	0.71	-
7.10.-	"	17.07	14.36	2.71	9.61	4.27	0.34	0.14	-
	"	7.20	6.13	1.07	2.15	1.51	1.95	0.53	-
	"	19.09	17.56	1.53	11.45	5.92	0.19	-	-
	"	11.07	8.76	2.31	6.61	0.46	1.07	0.62	-
28.10.-	"	9.79	8.23	1.56	5.51	2.45	0.20	0.07	-
	"	6.68	5.68	1.00	2.00	1.40	1.80	0.48	-
	"	17.82	16.39	1.43	10.69	5.52	0.18	-	-
	"	10.48	8.29	2.19	6.26	0.44	1.02	0.57	-
	"	133.05	125.01	8.04	58.60	52.24	6.76	1.12	6.29
	"	111.41	100.97	10.44	26.79	48.30	9.95	8.18	7.75
Total	"								
	"	157.97	151139	6.58	103.55	39.08	8.76	-	-
	"	115.76	107.48	8.28	57.25	11.76	8.46	10.43	19.58

(c) DRY MATTER YIELDS - ITALIAN RYEGRASS - PLOTS 5 and 8 (x 100 lbs/ac)

'0' - 1959

Date	Plot	Tot. DM/ac	Cor. DM/ac	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
22.7.59	5A	19.33	15.88	3.45	2.60	0.55		12.73
	5B	16.94	16.32	0.62	2.33	0.54		13.45
19.8.-	"	18.61	15.57	3.04	2.55	0.57		12.45
	"	14.43	13.91	0.52	1.99	0.46		11.46
	"	37.94	31.45	6.49	5.15	1.12		25.18
S/Tot.	"	31.37	30.23	1.14	4.32	1.00		24.91
16.9.-	"	14.87	13.58	1.29	0.59	0.27		12.72
	"	7.74	4.14	3.60	0.68	0.47	0.07	2.92
Grand	"	52.81	45.03	7.78	5.74	1.39		37.90
Total	"	39.11	34.37	4.74	5.00	1.47	0.07	27.83
6.7.59	8A	15.66	14.14	1.52	2.65	0.63		10.86
	8B	19.09	17.14	1.95	1.41	0.53		15.20
5.8.-	"	23.06	20.85	2.21	3.92	0.93		16.00
	"	25.26	22.68	2.58	1.87	0.71		20.10
	"	38.72	34.99	3.73	6.57	1.56		26.86
S/Tot.	"	44.35	39.82	4.53	3.28	1.24		35.30
1.9.-	"	25.25	19.85	5.40	2.80	2.22		14.83
	"	25.48	19.16	6.32	2.83	1.73		14.60
24.9.-	"	17.49	13.66	3.83	0.72	0.26		12.68
	"	17.90	13.82	4.08	0.81	0.39		12.62
	"	42.74	33.51	9.23	3.52	2.48		27.51
S/Tot.	"	43.38	32.98	10.40	3.64	2.12		27.22
Grand	"	81.46	68.50	12.96	10.09	4.04		54.37
Total	"	87.73	72.80	14.93	6.92	3.36		62.52

(d) DRY MATTER YIELDS -ITALIAN RYEGRASS - 'C' - (x 100 lbs/ac.) - 1959

Date	Plot	Tot. DM/ac	Cor. DM/ac	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
24.6.59	5A	12.37	11.72	0.65	3.62	1.32	0.99	5.79
	5B	15.19	14.62	0.57	4.97	1.75	T	7.90
15.7.-	"	15.97	15.12	0.85	4.68	1.71	1.27	7.46
	"	12.35	11.88	0.47	4.04	1.42	T	6.42
5.8.-	"	19.52	18.48	1.04	5.72	2.09	1.55	9.12
	"	17.27	16.61	0.66	5.70	2.02	T	8.89
26.8.-	"	18.93	17.93	1.00	5.55	2.03	1.51	8.84
	"	17.11	16.45	0.66	5.58	1.97	T	8.90
	"	66.79	63.25	3.54	19.57	7.15	5.32	31.21
S/Tot.	"	61.92	59.56	2.36	20.29	7.16	T	32.11
16.9.-	"	11.20	6.86	4.34	1.41	0.71	0.10	4.64
	"	11.93	7.32	4.61	2.75	1.14		3.43
7.10.-	"	9.44	5.78	3.66	1.19	0.59	0.08	3.92
	"	11.79	7.25	4.54	2.72	1.13		3.40
	"	20.64	12.64	8.00	2.60	1.30	0.18	8.56
S/Tot.	"	23.72	14.57	9.15	5.47	2.27		6.83
Grand	"	87.43	75.89	11.54	22.17	8.45	5.50	39.77
Total	"	85.64	74.13	11.51	25.76	9.43	T	38.94
24.6.59	5A(1)	18.64	17.58	1.06	4.29	1.49		11.80
	5B(1)	17.16	16.61	0.55	3.87	1.29	0.19	11.26
15.7.-	"	33.04	31.16	1.88	7.60	2.64		20.92
	"	37.74	36.53	1.21	8.53	2.83	0.42	24.75
5.8.-	"	32.62	30.76	1.86	7.50	2.61		20.65
	"	33.88	32.79	1.09	7.66	2.54	0.36	22.23
26.8.-	"	18.06	17.03	1.03	4.15	1.44		11.44
	"	20.21	19.54	0.67	4.56	1.50	0.22	13.26
	"	102.36	96.53	5.83	23.54	8.18		64.81
S/Tot.	"	108.99	105.47	3.52	24.62	8.16	1.19	71.50
16.9.-	"	13.38	10.66	2.72	2.72	0.96	T	6.98
	"	12.96	8.24	4.72	3.00	1.35	0.30	3.59
7.10.-	"	5.68	4.53	1.15	1.05	0.30	T	3.18
	"	6.24	3.95	2.29	1.40	0.60	0.15	1.80
	"	19.06	15.19	3.87	3.77	1.26	T	10.16
S/Tot.	"	19.20	12.19	7.01	4.40	1.95	0.45	5.39
Grand	"	121.42	111.72	9.70	27.31	9.42	T	74.97
Total	"	128.19	117.66	10.53	29.02	10.11	1.64	76.89

(e) DRY MATTER YIELDS - ITALIAN RYEGRASS- 'C' - (x 100 lbs/ac.) - 1959.

Date	Plot	Tot. DM/ac	Cor. DM/ac	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
24.6.59	8A	21.56	20.31	1.25	6.21	2.50		11.60
	8B	25.31	22.83	2.48	3.67	2.46		16.70
15.7.-	"	9.23	8.69	0.54	2.66	1.06		4.97
	"	24.24	21.89	2.35	3.52	2.35		16.02
5.8.-.	"	28.51	26.86	1.65	8.21	3.31		15.34
	"	30.98	27.98	3.00	4.49	3.01		20.48
26.8.-	"	18.24	17.19	1.05	5.25	2.12		9.82
	"	16.09	14.53	1.56	2.33	1.56		10.64
	"	77.54	73.05	4.49	22.33	8.99		42.73
S/Tot.	"	96.62	87.23	9.39	14.01	9.38		63.84
16.9.-	"	13.82	10.12	3.70	0.57	0.29	0.29	8.97
	"	13.39	9.31	4.08	0.63	0.24		8.44
7.10.-	"	7.92	5.79	2.13	0.32	0.16	0.17	5.14
	"	6.93	4.68	2.25	0.30	0.10		4.28
	"	21.74	15.91	5.83	0.89	0.45	0.46	14.11
S/Tot.	"	20.32	13.99	6.33	0.93	0.34		12.72
Grand	"	99.28	88.96	10.32	23.22	9.44	0.46	55.84
Total	"	116.94	101.22	15.72	14.94	9.72		76.56
24.6.59	8A(1)	24.31	23.19	1.12	3.35	1.51		18.33
	8B(1)	22.14	21.08	1.06	2.99	1.26	T	16.83
15.7.-	"	36.13	34.47	1.66	4.99	2.24		27.24
	"	31.58	30.07	1.51	4.27	1.80	T	24.00
5.8.-	"	52.39	49.98	2.41	7.23	3.25		39.50
	"	55.51	52.81	2.67	7.50	3.15	T	42.19
26.8.-	"	24.51	23.38	1.13	3.38	1.52		18.48
	"	19.43	18.50	0.93	2.62	1.11	T	14.77
	"	137.34	131.02	6.32	18.95	8.52		103.55
S/Tot.	"	128.66	122.49	6.17	17.38	7.32	T	97.79
16.9.-	"	13.90	11.04	2.86	2.70	1.35	T	6.99
	"	16.42	11.22	5.20	1.40	0.82	0.28	8.72
7.10.-	"	13.76	10.93	2.83	2.67	1.33	T	6.93
	"	14.97	10.27	4.70	1.27	0.75	0.25	8.00
	"	27.66	21.97	5.69	5.37	2.68	T	13.92
S/Tot.	"	31.39	21.49	9.90	2.67	1.57	0.53	16.72
Grand	"	165.00	152.99	12.01	24.32	11.20	T	117.47
Total	"	160.05	143.98	16.07	20.05	8.99	0.53	114.51

(f) DRY MATTER YIELDS - TALL FESCUE-CLOVER - 'O' and 'C'

(x 100 lbs/ac.) - 1959

'O'

Date	Plot	Tot. DM/ac.	Cor. DM/ac	Burn & Soil	White Clover	Leaf	Stem	Other Grass	Other Weeds
16.6.59	7A	8.68	8.51	0.17	T	0.09	0.05	0.09	8.28
	7B	9.57	9.51	0.06	0.03	0.08	0.03	0.32	9.05
15.7. -	"	14.51	14.21	0.30	T	0.15	0.09	0.15	13.82
	"	15.64	15.55	0.09	0.05	0.13	0.05	0.52	14.80
	"	23.19	22.72	0.47	T	0.24	0.14	0.24	22.10
S/Tot.	"	25.21	25.06	0.15	0.08	0.21	0.08	0.84	23.85
4.9.-	"	24.61	23.97	0.64	1.48	1.16	0.49	1.65	19.19
	"	27.85	27.27	0.58	1.34	2.48	0.72	1.48	21.25
Grand	"	47.80	46.69	1.11	1.48	1.40	0.63	1.89	41.29
Total	"	53.06	52.33	0.73	1.42	2.69	0.80	2.32	45.10

'C'

24.6.59	7A	13.68	13.54	0.14	1.63	0.27	0.14	1.08	10.42
	7B	25.12	24.68	0.44	0.98	0.36	0.14	0.36	22.84
15.7. -	"	16.28	16.12	0.16	1.94	0.33	0.16	1.28	12.41
	"	17.78	17.50	0.28	0.70	0.25	0.09	0.26	16.20
5.8.-	"	31.62	31.20	0.42	3.76	0.63	0.32	2.40	24.09
	"	26.04	25.54	0.50	1.02	0.36	0.13	0.36	23.67
26.8.-	"	22.30	22.08	0.22	2.65	0.45	0.22	1.76	17.00
	"	18.77	18.41	0.36	0.74	0.26	0.09	0.26	17.06
	"	83.88	82.94	0.94	9.98	1.68	0.84	6.52	63.92
S/Tot.	"	87.71	86.13	1.58	3.44	1.23	0.45	1.24	79.77
16.9.-	"	22.78	17.09	5.69	6.97	2.53	0.64	0.62	6.33
	"	18.22	16.45	1.77	4.14	0.77	0.24	0.29	11.01
7.10. -	"	9.25	6.94	2.31	2.83	1.03	0.26	0.25	2.57
	"	16.65	15.04	1.61	3.78	0.70	0.22	0.27	10.07
	"	32.03	24.03	8.00	9.80	3.56	0.90	0.87	8.90
S/Tot.	"	34.87	31.49	3.38	7.92	1.47	0.46	0.56	21.08
Grand	"	115.91	106.97	8.94	19.78	5.24	1.74	7.39	72.82
Total	"	122.58	117.62	4.96	11.36	2.70	0.91	1.80	100.85

APPENDIX 19.

(a) DRY MATTER YIELDS -ITALIAN RYEGRASS -PLOT 7 (x100lbs/ac.)-1958

' 0 '

Date	Plot	Tot. DM./ac.	Cor. DM./ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds	Plot DM.
8.4.58	7A	9.60	9.60	-	9.60	-	-	-	18.23
	7B	10.35	10.35	-	10.35	-	-	-	18.63
12.5.-	"	7.27	7.27	-	6.87	0.17	0.17	0.06	13.81
	"	10.51	10.51	-	10.01	0.21	0.12	0.17	18.92
S/Tot.	"	16.87	16.87	-	16.64	-	0.17	0.06	
	"	20.86	20.86	-	20.57	-	0.12	0.17	
6.6.-	"	11.80	11.80	-	7.33	3.59	0.88	-	22.42
	"	9.44	9.44	-	5.86	3.05	0.45	0.08	17.90
14.7.-	"	20.90	20.54	0.36	6.44	12.18	1.92	-	39.03
	"	24.04	23.49	0.55	7.55	11.18	4.47	0.29	42.08
27.8.-	"	24.16	23.89	0.27	12.08	8.14	3.67	-	45.40
	"	25.15	24.95	0.20	19.23	4.12	1.60	-	44.91
S/Tot.	"	45.06	44.43	0.63	38.84	20.32	5.59	-	
	"	49.19	48.44	0.75	42.08	15.30	6.07	0.29	
20.10.-	"	30.12	24.64	5.48	11.72	3.59	8.43	0.90	46.81
	"	31.33	28.96	2.37	10.34	4.73	13.89	-	52.10
Grand Total	"	103.85	97.74	6.11	54.04	27.67	15.07	0.96	185.70
	"	110.82	107.70	3.12	63.34	23.29	20.53	0.54	194.54

19. contd.

(b) DRY MATTER YIELDS -ITALIAN RYEGRASS-PLOT 7 (±100 lbs/ac.) 1958

' C '

Date	Plot	Cor. DM./ac.	Cor. DM/ac.	Burn & Soil	Leaf	Stem	Other Grass	Other Weeds
1.4.58	7A	7.52	7.52	-	7.52	-	-	T
	7B	9.77	9.77	-	9.77	-	-	T
22.4.-	"	13.39	13.39	-	13.39	-	-	-
	"	16.63	16.63	-	16.63	-	-	-
13.5.-	"	26.11	26.11	-	18.56	6.35	0.86	0.34
	"	23.24	23.24	-	14.30	8.62	0.16	0.16
S/Tot.	"	47.02	47.02	-	39.47	6.35	0.86	0.34
	"	49.64	49.64	-	40.70	8.62	0.16	0.16
3.6.-	"	16.82	16.82	-	6.21	9.12	1.19	0.30
	"	14.56	14.56	-	3.65	9.86	0.28	0.77
24.6.-	"	21.28	20.13	1.15	5.66	9.32	4.98	0.17
	"	20.42	19.11	1.31	6.50	9.47	2.96	0.18
15.7.-	"	24.91	23.56	1.35	6.63	10.91	5.83	0.19
	"	31.56	29.54	2.02	10.04	14.64	4.58	0.28
5.8.-	"	18.61	17.61	1.00	4.96	8.15	4.35	0.15
	"	14.00	13.10	0.90	4.45	6.50	2.05	0.12
26.8.-	"	20.86	19.73	1.13	5.55	9.14	4.88	0.16
	"	16.82	15.74	1.08	5.35	7.80	2.44	0.15
S/Tot.	"	85.66	81.03	4.63	22.80	37.52	20.04	0.67
	"	82.80	77.49	5.31	26.34	38.41	12.01	0.73
16.9.-	"	17.02	16.63	0.39	5.70	1.55	7.25	2.13
	"	15.15	13.23	1.92	6.91	2.88	3.26	0.18
7.10.-	"	15.05	14.70	0.35	5.13	1.28	6.41	1.88
	"	13.28	11.59	1.69	6.06	2.51	2.86	0.16
28.10.-	"	11.18	10.92	0.26	3.81	0.95	4.76	1.40
	"	10.43	9.11	1.32	4.76	1.98	2.24	0.13
S/Tot.	"	43.25	42.25	1.00	14.64	3.78	18.42	5.41
	"	38.86	33.93	4.93	17.73	7.37	8.36	0.47
Grand Total	"	192.75	187.12	5.63	83.12	56.77	40.51	6.72
	"	185.86	175.62	10.24	88.42	64.26	20.81	2.13

APPENDIX 20

INTAKE STUDIES - H15 - ITALIAN RYEGRASS - 1958

(a) First Study - Faeces

Plot	Day	Faeces (Grams)	% Ash	Mg. Cr_2O_3 (mmg.)	% N
7A	1	1969.17	15.90	4.10	3.11
7B	1	1286.90	17.15	6.18	2.98
"	2	1143.05	15.70	7.08	2.90
"	2	1294.83	17.05	6.15	2.85
"	3	1265.59	15.10	6.44	2.93
"	3	1348.95	15.55	6.01	2.80
"	4	1107.89	14.60	7.40	2.82
"	4	1605.09	15.90	5.03	2.78
"	5	1295.70	14.70	6.32	2.77
"	5	1528.42	15.30	5.32	2.63
"	6	1284.47	13.70	6.45	2.74
"	6	1305.26	14.75	6.27	2.64
"	7	1353.37	13.30	6.15	2.68
"	7	1332.12	14.80	6.14	2.57
"	8	1568.85	13.55	5.29	2.59
"	8	1666.23	15.30	4.88	2.54

(b) Second Study - Faeces

7A	1	1519.51	22.60	4.89	3.05
7B	1	1463.29	22.72	5.07	2.97
"	2	1588.62	20.90	4.78	3.08
"	2	1277.71	23.87	5.72	3.00
"	3	1592.42	21.54	4.73	3.08
"	3	1609.46	22.88	4.60	2.94
"	4	1629.53	20.73	4.67	3.05
"	4	1511.66	22.37	4.93	2.98
"	5	1542.35	22.56	4.82	3.05
"	5	1652.05	22.56	4.50	2.94
"	6	1535.22	20.68	4.96	2.97
"	6	1531.67	22.14	4.88	2.86
"	7	1894.86	20.85	4.01	2.96
"	7	1559.76	19.90	4.93	2.86
"	8	1700.32	20.12	4.51	2.95
"	8	1624.90	22.14	4.60	2.80

APPENDIX 21

COMPARISON OF SAMPLING TECHNIQUES
(GRAMS ORGANIC MATTER)

(a) Spring - 1959

Quadrat (6'x1')	Tarpen (6'x1')	Tarpen Residue (6'x1')	Sheep Shears (4x6'x3")
144.33	130.23	23.5	115.35
171.84	98.44	43.6	119.14
133.66	113.36	27.2	105.60
167.63	130.01	39.3	128.32
123.54	91.99	35.5	103.91
130.82	107.99	47.2	127.13
132.84	97.46	22.6	99.01
104.76	79.21	32.6	69.60
140.06	107.76	33.3	116.82
173.25	80.17	65.7	107.10
77.36	121.84	33.7	179.56
186.36	170.60	35.0	119.71
179.33	128.17	28.0	148.93
127.48	95.58	28.3	113.94
153.81	93.50	42.3	109.47
135.63	130.05	29.6	107.25
129.05	94.28	23.6	105.63
194.27	89.92	56.2	117.00
157.00	141.96	34.3	172.14
196.74	136.90	32.3	191.13
Tot. 2959.76	2239.42	713.8	2456.74

(b) Summer - 1959

		Quadrat 2(2 4/5"x 3")	
179.77	91.00	6.35	83.13
134.88	80.19	10.39	97.34
127.83	95.92	4.49	124.79
129.68	79.29	5.10	62.84
108.03	67.49	4.12	77.08
97.75	58.31		105.37
143.59	80.55	6.10	112.02
164.05	84.13		110.38
208.26	95.79	5.41	170.65
185.92	83.79	4.14	140.28
206.18	128.41	9.46	123.99
213.85	89.50	5.80	176.81
235.48	84.77	6.72	154.66
198.72	77.14	8.37	148.88
150.15	102.60	5.05	126.98
263.56	140.78	12.60	182.71
269.74	191.62		230.80
224.70	87.30	4.42	197.30
218.90	81.70	10.67	200.74
245.43	111.75	9.44	176.40
Tot. 3706.47	1912.03	118.63	2803.15

21. contd.

(c) Autumn - 1959

Shear (6' x 3")	Quadrat (6' x 1')	Shear (6' x 3")	Quadrat (6' x 1')
28.37	174.28	15.03	108.75
15.08	126.37	23.52	151.28
15.18	95.66	26.37	157.50
10.12	65.26	18.80	150.06
13.80	68.75	28.80	145.20
15.10	90.63	36.59	180.87
15.92	86.97	39.01	211.01
15.63	97.22	41.21	236.35
11.28	63.82	30.89	195.15
8.60	71.86	31.07	143.10
13.20	106.38	31.43	152.35
8.15	63.87	31.54	150.79
14.78	86.76	19.83	121.90
10.31	85.56	14.84	105.28
12.48	83.65	12.69	95.89
11.42	74.36	17.51	77.47
15.49	81.09	16.34	84.65
12.37	83.74	14.39	91.53
16.08	88.53	16.36	75.72
14.47	92.12	27.57	151.06
9.94	89.24	27.72	143.45
11.12	83.30	20.15	133.70
14.24	85.96	35.24	164.25
29.51	126.51	32.49	160.74
27.78	138.08	29.89	182.64
20.80	113.46	34.99	190.22
27.33	112.59	42.23	197.80
13.46	72.90	26.20	162.82
18.22	98.22	21.56	140.76
13.23	79.90	22.46	119.31
12.15	74.53	20.83	105.17
14.06	93.40	15.52	97.75
17.97	105.69	13.40	104.04
11.18	79.24	15.05	104.66
19.53	108.74	15.86	104.21
22.41	133.95	17.73	115.39
12.92	94.32	29.32	171.59
23.88	133.61	36.56	178.63
40.14	184.93	24.42	145.17
27.85	175.09	35.20	183.89
27.20	161.36	22.55	151.25
36.00	189.58	36.64	194.37
28.15	163.62	31.95	188.51
14.25	106.24	21.81	137.41
20.01	111.55	25.63	152.50
20.52	122.98	26.86	137.56
17.84	109.48	24.81	146.37
15.26	96.38	23.40	132.12
19.58	107.23	13.90	87.32
19.11	114.99	17.04	88.23
Total		2138.67	12,361.68